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Date of Deposit June 20, 2001.

FORM PTO-1390 (REV. 5-93) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		CASE NO. 11086/3 U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5) 09/868746
INTERNATIONAL APPLICATION NO. PCT/EP99/07884	INTERNATIONAL FILING DATE October 18, 1999	PRIORITY DATE CLAIMED October 18, 1999

TITLE OF INVENTION
METHOD FOR ROUTING MESSAGES IN A TELECOMMUNICATIONS NETWORK

APPLICANT(S) FOR DO/EO/US
Roger Brünig, Katharina Dierkes, Armin Hüwels; Christian Müller, Michael Reich, and Ulrich Sundermann

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371
2. ☐ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
8. ☒ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☒ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)) and/or amendments under Article 34.

Items 11. to 16. Below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
    ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☒ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☐ Other items or information: Form PTO-1449, 5 cited references, second copy of translation of published International Application; and return postcard

U.S. APPLICATION NO. (if known, see 37 CFR 1.5) 09/868746	INTERNATIONAL APPLICATION NO. PCT/EP99/07884	CASE NO. 11086/3

17.☒ The following fees are submitted:	CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EPO or JPO $860.00		
International preliminary **examination** fee paid to USPTO (37 CFR 1.492(a)(1)) $690.00		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international **search** fee paid to USPTO (37 CFR 1.492(a)(2)) $710.00		
Neither international preliminary **examination** fee (37 CFR 1.482) nor international search fee (37 CFR 1.492(a)(3)) paid to USPTO $1,000.00		
International preliminary examination **fee** paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) $100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT	$860	
Surcharge of $130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).		

Claims	Number Filed	Number Extra	Rate		
Total Claims	17- 20 =	0	x $ 18.00		
Independent Claims	2- 3 =	0	x $ 80.00		
Multiple dependent claim(s) if Applicable)		0	+ $270.00		
			TOTAL OF ABOVE CALCUATIONS =	$860	
Reduction by ½ for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28)					
			SUBTOTAL =	$	
Surcharge of $130.00 for furnishing the English translation later than the ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				$	
			TOTAL NATIONAL FEE=	$860	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31), $40.00 per property +					
			TOTAL FEES ENCLOSED=	$860	
				Amount to be refunded	$
				charged	$

a. ☒ A check in the amount of $860 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. 23-1925 in the amount of $ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 23-1925. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

Send All Correspondence to:
Brinks Hofer Gilson & Lione
P.O. Box 10395
Chicago, IL 60610

Signature
Matthew J. Kelly
Name
42,716
Registration Number

"Express Mail" mailing label number EL500980010US

Date of Deposit: June 20, 2001

Our Case No. 11086/3

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Brünig et al.

Serial No. Unassigned

PCT/EP99/07884

Filing Date: Oct. 18, 1999

Examiner: Unassigned

Group Art Unit No. Unassigned

For :

METHOD FOR ROUTING MESSAGES IN AT LEAST ONE TELECOMMUNICATION NETWORK ACCORDING TO THE GSM STANDARD

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Please enter this preliminary amendment in the above captioned application as set forth below. Applicant respectfully requests that this preliminary amendment be entered and the case be allowed to issue.

1. IN THE CLAIMS

Please delete claims 1 - 12.

Please add the following claims:

--13. A network address register for use in a telephone switching network to route messages, comprising:

a database comprising subscriber-specific data and network item addresses; and

a network address register that receives a network message and determines a network item address for the network message as a function of the subscriber-specific data in the message using the database. --

--14. The network address register of claim 13, wherein the network address register is capable of being used in a Global System for Mobile Communications network.--

--15. The network address register of claim 14, wherein the subscriber-specific data comprises one or more elements selected from the group consisting of: mobile station ISDN number, international mobile subscriber identity, and international mobile equipment identity.--

--16. The network address register of claim 14, wherein the network items comprises one or more elements selected from the group consisting of: home location register, an authentication center, equipment identity register, service control point, and a voice mail service center.--

--17. The network address register of claim 14, wherein the network address register returns routing information to a network item that sent the network message.--

--18. The network address register of claim 14, wherein the database comprises an association between the subscriber-specific data and network item addresses such that the network item addresses are independent of block numbering ranges.--

--19. The network address register of claim 18, wherein the association between the scriber-specific data and network item addresses is configurable.--

--20. A method of routing messages in a Global System for Mobile Communications switching network, comprising:

receiving a network message having subscriber-specific data at a network address register from a first network item;

determining at the network address register a network address of a second network item as a function of the subscriber-specific data; and

transmitting the network message to the network address of a second network item.--

--21. The method of claim 20, wherein the second network item replies directly to the first network item. --

--22. The method of claim 21, wherein the first network item comprises a mobile services switching center, the second network item comprises a home location register, and the subscriber-specific data comprises an international mobile subscriber identity.--

--23. The method of claim 22, wherein the subscriber-specific data further comprises a mobile station ISDN number.--

--24. The method of claim 21, further comprising:

transmitting the network address of the second network item to the first network item.--

--25. The method of claim 24, further comprising:

establishing a traffic channel with the second network item, wherein the first network item comprises a mobile services switching center, the second network item comprises a voice mail service center, and the subscriber-specific data comprises an mobile station ISDN number. --

--26. The method of claim 25, wherein the traffic channel comprises a voice channel to a voice mailbox.--

--27. The method of claim 26, further comprising:

transmitting the mobile station ISDN number from the voice mail service center to the network address register; and

determining in the network address register a network address of the home location register as a function of the mobile station ISDN number. --

--28. The method of claim 27, further comprising:

transmitting an international mobile equipment identity of a portable radio device from the mobile services switching center to the network address register; and

determining in the network address register the address of the service control point as a function of the international mobile equipment identity.--

--29. The method of claim 28, further comprising:

receiving an international mobile subscriber identity from the mobile services switching center at the network address register;

determining in the network address register the address of the authentication center as a function of the international mobile subscriber identity; and

providing authentication of the international mobile subscriber identity to the mobile services switching center.--

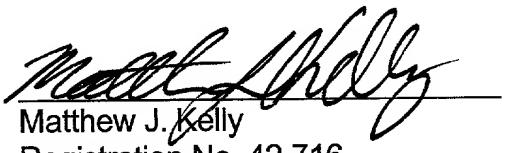
REMARKS

After the preliminary amendment, Claims 13-29 are pending in the case. Applicant respectfully submits that the preliminary amendment places the case in a condition for allowance.

VI. CONCLUSION

In view of the above remarks, Applicant respectfully requests consideration of the claims and that all the claims be allowed. If a telephone interview would expedite issuance of the present application, the Examiner is requested to contact the undersigned at (312) 321-4282.

Respectfully submitted,



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METHOD FOR ROUTING MESSAGES IN AT LEAST ONE TELECOMMUNICATIONS NETWORK ACCORDING TO THE GSM STANDARD

Description

Genus

The present invention relates to a method for routing messages in at least one telecommunications network according to the GSM standard having one or more network elements with subscriber-specific data.

Related Art

In GSM mobile telephony networks, the subscriber data for the mobile telephone subscriber is maintained in a central data base, the Home Location Register (HLM). As the number of subscribers and, therefore, the need for call numbers, increases, the relationships between the planning for the HLR, SIM card, and VMSC become considerably more complex due to the need to form blocks of call numbers and distribute them to the HLR's and VMSC's. The planning principle, which is made more difficult due to special-request call numbers, with consideration for the formation of blocks for MSISDN and IMSI, reaches the limits of its capability as the complexity increases. Due to the systems engineering-based capacity limitations of an HLR, mobile telephony networks having a large number of subscribers typically have more than one HLR, in order to accept data from all subscribers. The determination as to which HLR the respective subscriber data record will be stored in is made based on the call numbers of the

mobile telephone subscriber (MSISDN mobile station ISDN number) or its IMSI (the determination must be made one time at the start of the network).

In addition to the HLR's, there are other network elements that contain subscriber-specific data, such as the Service Control Points (SCP) with integrated Service Data Function (SDF) in the Intelligent Network (IN) or the Voice Mail Center (VMSC's) as the central automatic answering service in the switched network.

Since all GSM subscriber data are stored in the HLR's and a subscriber is identified by his MSISDN (e.g., in the case of an MTC) or his IMSI (e.g., in the case of a location update), the MSC/VLR, for instance, must be able to determine the HLR of the subscriber based on the MSISDN or the IMSI. Due to capacity and administrative limits, all individual call numbers and IMSI's cannot be stored in the MSC routing table. As mentioned previously, blocks are therefore defined, each of which is assigned to a certain HLR and for which the routing is installed accordingly in the MSC. Since the individual IMSI of the respective subscriber is programmed in the SIM cards, the combination of SIM card and call number must match when the subscriber is activated and they must be assigned to the same HLR. If this is not the case, "virtual subscriber entries" arise in the HLR for which only limited capacity is available.

An estimate of the likely development of subscriber distribution to HLR's, broken down according to real and virtual subscribers, becomes increasingly more difficult as the number of subscribers and/or HLR's increases. The situation can be intensified by the fact, for instance, that a further network identification number is introduced.

The fact that customers may request specific call numbers makes the situation more difficult because all of the call-number space available for activation is already set up in the MSC's and distributed to the existing HLR. This is what the

HLR splits can be traced back to: when a new HLR is put into service, call-number and IMSI ranges must be assigned to this as well so that subscribers can be activated in this new HLR.

The assignments described above characterize the HLR roll-out to the same extent as call-number allocation and numbering planning by the Voice Mail Service Center (VMSC). This results not only in an immense amount of planning work that must be carried out, but a high susceptibility for error as well. It also results in a waste of HLR capacity.

Similar considerations as those posed in conjunction with the HLR can also result for other network elements having subscriber-specific data. Just as the subscriber data for GSM services are stored in the HLR, the subscriber data for the Intelligent Network services of a subscriber are stored in the Service Control Point (SCP), for instance.

Object

The invention is based on the object of further developing a method of the type required by the genus to the extent that, for at least one telecommunications network according to the GSM standard, the HLR planning is separated from call-number allocation and SIM card requests, and generation of the system characteristics are separated from MSISDN/IMSI distribution, while improving network quality by eliminating virtual subscriber entries.

The invention is further based on the object of expanding this procedure individually and flexibly to all elements that refer to subscriber-specific data, such as HLR, AUC, EIR, VMSC, SMSC and SCP.

Solution

The object is solved using the features described in **Claim 1.**

Further Inventive Forms

Further inventive forms are described in **Claims 2** through **12.**

A Few Advantages

Summary

As a new network element, the Network Address Register, designed as a routing computer, has the primary objective in a telecommunications network, such as a mobile telephony network, of making it possible for telecommunication subscribers, such as mobile telephone subscribers, to be assigned individually to the network elements involved, such as HLR's. This renders unnecessary the previously required formation of blocks of call numbers and their distribution, to the HLR's, for instance, because it is eliminated by the NAR.

By preventing virtual HLR entries altogether, which represent a frequent source of error in the effective network as well as the subscriber activation environment, quality is improved.

When the method provided by the invention is used, the NAR eliminates the need for some network elements, such as new HLR's, due to better capacity utilization of existing network elements. As a result, the method according to the invention becomes profitable in a short period of time in spite of the investments associated with the use the NAR. Additional savings result in the area of numbering planning, call-number administration and SIM card distribution, which

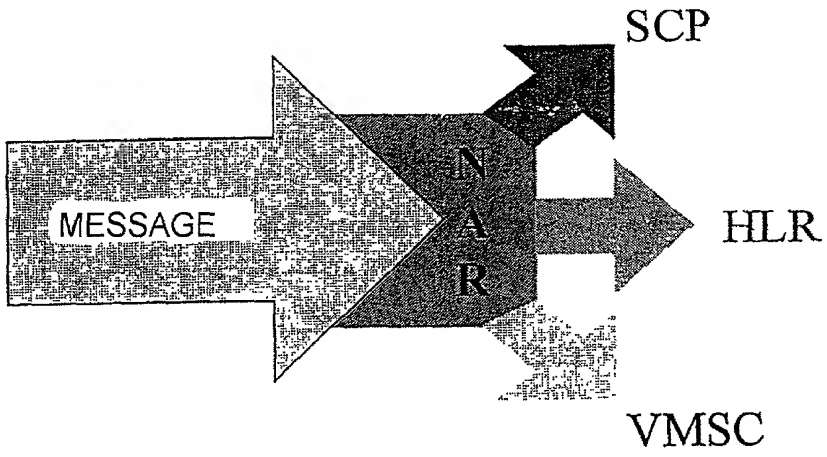
can be greatly simplified with the NAR, thereby making them more efficient and cost-effective.

The NAR does not result in incompatibility with existing services, network elements and functions in a telecommunications network.

Depending on the strategy for the telecommunications network involved, the NAR can also be used in principle for further applications described in the claims and possibly for future applications as well, such as the implementation of Mobile Number Portability (MNP).

Since the NAR is a routing computer, its software is adapted to specific requirements.

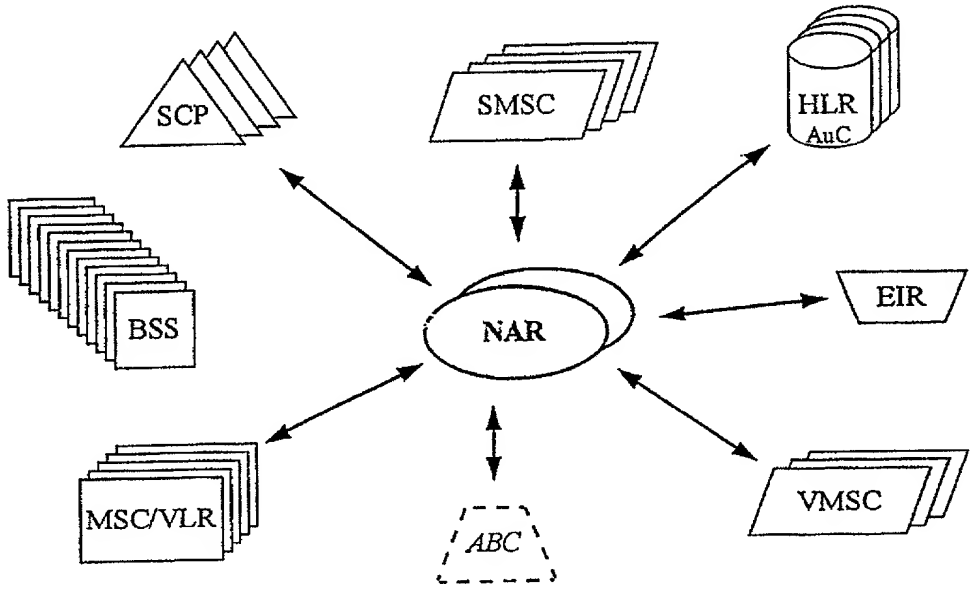
The object of an NAR, therefore, is to determine the correct network element, such as an HLR, for a message so that the message can be relayed there, in this manner, for instance:



NAR as a central message buffer

The NAR is therefore integrated in an existing GSM network which is expanded to include the network elements of the Intelligent Network (IN). In addition to the

classical GSM and IN network elements, the network elements for the value-added services, such as short-message service and automatic answering, must also be taken into consideration, which results in the following global overview of the NAR:



NAR in the GSM network

A direct signalling relationship between all network elements with each other is not given.

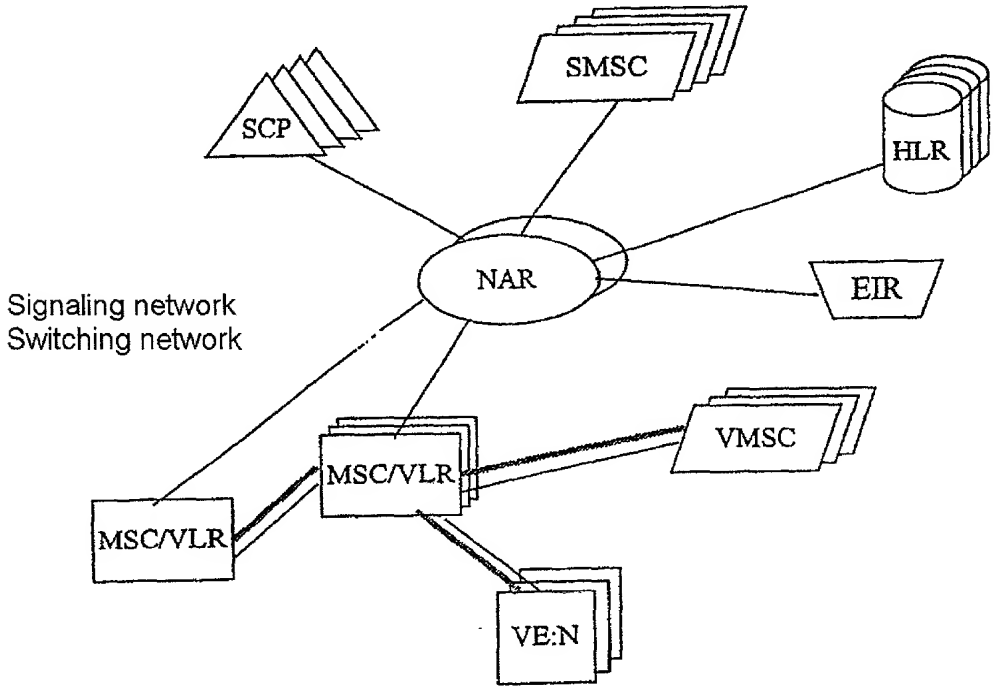
The NAR, as an effective network element, *[is]* an interface with the administration system (AdC).

The NAR is integrated directly as a network element in the call set-up phase for Mobile Terminating Calls (MTC), for instance. This results in special requirements on performance, in order to extend the call set-up times for MTC's by as little as possible, for instance.

The NAR can be used in the signalling network as a duplicated central network element.

Since the NAR is used in the signalling network and not the switched network, no traffic channels are carried over the NAR, either. Therefore, loops of traffic channels do not form.

The following structure therefore results:



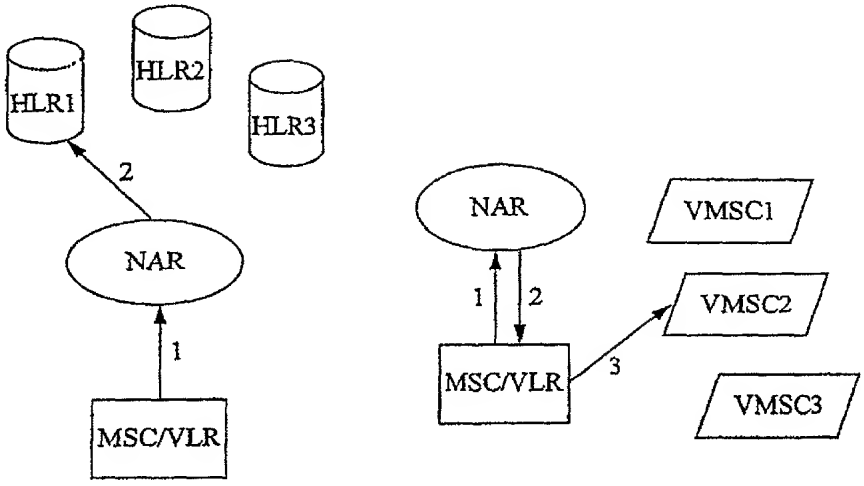
NAR in the signalling network

Depending on the application field used, e.g., routing to the HLR or optimized VMSC routing, the NAR therefore has the object of

a) determining a network element and relaying the respective message to it (e.g., MAP Send-Routing-Information to the HLR), or

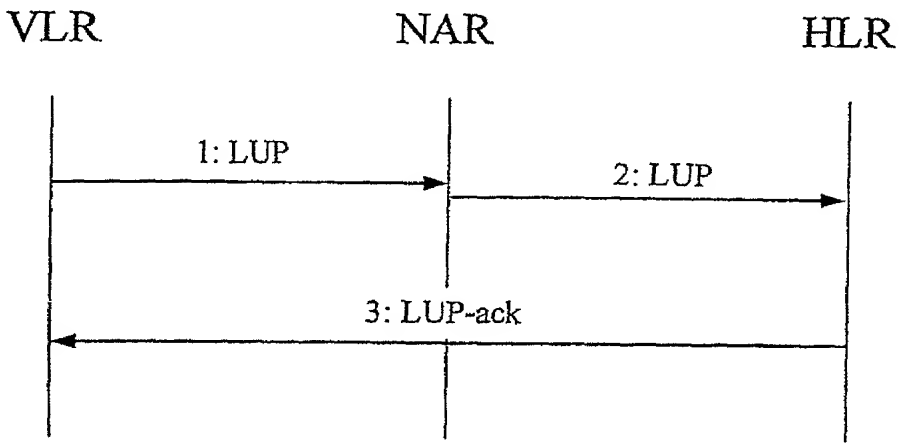
b) determining a network element address and returning this as routing information to the inquiry system (e.g., INAP: initial DP + Connect), so that the inquiry system can relay the message itself. This can be illustrated in a simplified manner as follows:

Transit Function **Final Function**



Transit and final function of the NAR

As mentioned, the message flow should be designed in such a way that the performance of the NAR is impaired as little as possible. A message flow for the case "Update Location" between MSC/VLR, NAR and HLR is shown in the following diagram as an example:



Message flow VLR, NAR and HLR

The addressing in the individual network elements is carried out as follows:

Addressing based on the IMSI of the subscriber:

1: VLR: MTP: DPC = SPC of the NAR, OPC = SPC of the VLR
SCCP: called party number = "IMSI" (E.214; E.212)
calling party number = VLR address (E.164)

The Global Title Analysis is set up in the VLR in such a way that the SPC of the NAR is always used as the DPC.

2. NAR: MTP: DPC = SPC of the HLR, OPC = SPC of the NAR
SCCP: called party number = "IMSI" (E.214; possibly E.212)
calling party number = VLR address (E.164)

A Global Title Translation is carried out in the NAR, the result of which is the SPC of the HLR, which is used as the new DPC.

3. HLR: MTP: DPC = SPC of the VLR, OPC = SPC of the HLR
SCCP: called party number = VLR address (E.164)
calling party number = HLR address (E.164)

These addressing mechanisms are comparable to existing mechanisms in GSM mobile telephony networks.

Addressing based on the MSISDN of the subscriber:

1. VLR: MTP: DPC = SPC of the NAR, OPC = SPC of the VLR
SCCP: called party number = MSISDN (E.164)
calling party number = VLR address (E.164)

The Global Title Analysis is set up in the VLR in such a way that the SPC of the NAR is always used as the DPC.

2. NAR: MTP: DPC = SPC of the HLR, OPC = SPC of the NAR
SCCP: called party number = MSISDN (E..164)
calling party number = VLR address (E.164)
A Global Title Translation is carried out in the NAR, the result of which is the SPC of the HLR, which is used as the new DPC.

3. HLR: MTP: DPC = SPC of the VLR, OPC = SPC of the HLR
SCCP: called party number = VLR address (E.164)
calling party number = HLR address (E.164)

As an alternative to this, it is possible to decode the messages in the NAR up to the application layer and then, based on the information obtained there (IMSI or MSISDN), carry out the further routing.

Since the NAR, as the only effective network element, still contains the allocation on which physical network element the subscriber-specific data are located, e.g., on which physical HLR the subscriber data record of a certain subscriber is located, correspondingly high requirements are to be placed on the NAR with regard for failure safety and reliability. If an NAR is no longer available, for instance, this corresponds to a failure of all network elements involved, such as all HLR's in one conventional GSM network. In this case, a successful MTC can no longer be carried out, but MOC's are still possible. The availability of value-added services and Mobility Management are seriously impaired as well. For these reasons, the network structure must provide a high degree of additional security. The use of duplicated systems in the network configuration is therefore meaningful for the NAR as well.

If the method according to the invention is considered in conjunction with HLR planning, the results are as follows:

- Allocation of IMSI/MSISDN ranges to HLR is eliminated
- Virtual subscriber entries are prevented.

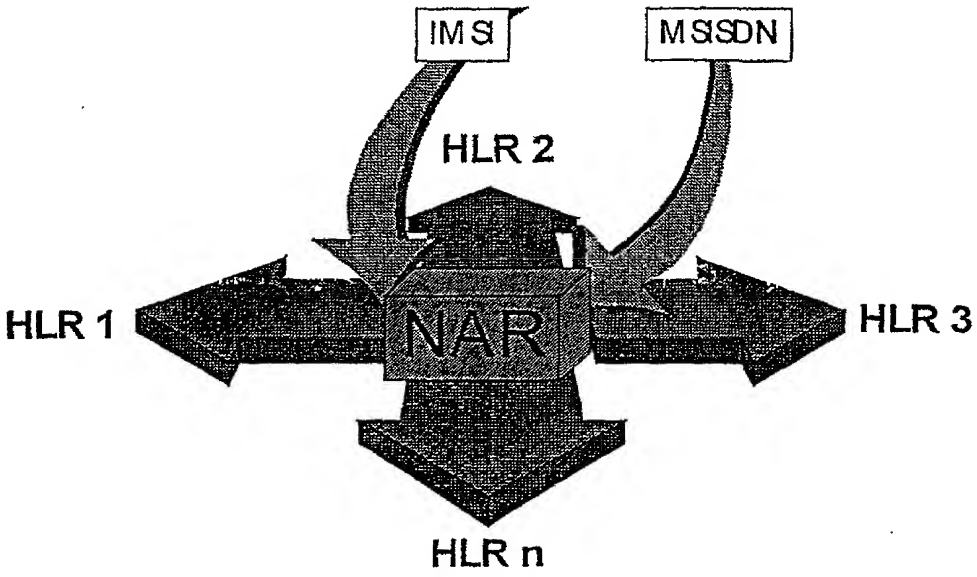
The following gains are achieved as a result:

- HLR planning is separated from call-number allocations and SIM card production

- Representation of system characteristics in the MSC is separated from MSISDN/IMSI distribution

- Network quality is improved due to the elimination of virtual subscribers, which are often erroned.

When the NAR is introduced, therefore, a change in the routing principles in a telecommunications network, e.g., a mobile telephony network, is given, because a subscriber-specific allocation of MSISDN/IMSI to HLR, for instance, is given. The data base with the allocation is located in the NAR and must therefore be incorporated when inquiries are sent to the HLR. The routing criteria for this example are the MSISDN and the IMSI, which results in the following global overview:



The NAR as an "HLR router"

Mobility Management

During inscription in the telecommunications network involved, e.g., for a mobile telephony network, after the location (VLR range) is changed or when the mobile telephone is reactivated, the new location is reported to the HLR, so that the corresponding data can be updated as necessary. The identification of the subscriber is carried out using the IMSI. In the response, the HLR sends its network address to the VLR. From this point forward, the VLR knows the HLR address of the subscriber. All further messages are sent directly from the VLR to the HLR based on this network address. (MAP: update location; IMSI; VLR → HLR).

Call Control

When a call is placed to a mobile subscriber (MTC), the Gateway MSC queries the HLR regarding the current location of the called party. The inquiry is carried

out based on the subscriber call number (MSISDN). (MAP: Send-Routing Information; MSISDN; GSMC → HLR).

Short Message

In the case of a short message that is to be allocated to a mobile subscriber, the Short Message Service Center (SMCS) must query the HLR for the location of the called party. Using the MSISDN, the NAR must therefore determine which HLR to relay the message Send-Routing-Information-For-SM. If the target party cannot be reached (e.g., his mobile telephone is turned off), the SMSC can order the HLR to inform it when the party becomes available, so that the short message can be relayed once more. (MAP: Send-Routing-Information-For-SM; MSISDN; SMSC → HLR) (MAP: Set-Message-Waiting Data; MSISDN; SMSC → HLR).

Value-Added Services

None of the actions carried out as value-added services from the VLR toward the HLR require any additional functions in the NAR. The associated messages are routed by the VLR to the corresponding HLR based on the network address of the HLR stored for the respective party.

All value-added services that are carried out by network elements other than the VLR require that the NAR relay the Supplementary Service Operation to the "correct" HLR, because the HLR network address for a certain subscriber is not known by the other network elements. A supplementary service can also be initiated by a VMSC, for instance.

The subscriber can administrate the value-added services using a Voice Mail Service Center (VMSC), for instance. A MAP interface between VMSC and HLR is required for this. Since the VMSC does not know the network address of the

HLR for the subscriber who is handling its value-added service, the NAR must relay the MAP message to the HLR based on the IMSI.

A similar solution can also be achieved using an Interactive Voice Response (IVR) platform, for instance, instead of a VMSC.

Authentication Center (AuC)

In a mobile telephony network, the function of the AuC can also be integrated in each HLR for the subscriber data records stored in this HLR. To perform authentication, the VLR queries the AuC for the necessary parameters. Since the network address of the HLR is not yet known in the VLR when the subscriber is first inscribed in the network, the NAR must relay the MAP messages for authentication to the HLR/AuC based on the IMSI.
(MAPv1: Send-Parameters; IMSI; VLR → HLR/AuC)
(MAPv2: Send-Authentication-Info; IMSI; VLR → HLR/AuC)

SIM Card Handling

There are situations in which the SIM card of an existing subscriber must be replaced, e.g., when an SIM card is defective or when new services are introduced. These subscribers want to retain their old call numbers. This means that, while the MSISDN remains the same, a new IMSI is assigned to the subscribers. The NAR, with the ability to flexibly allocate MSISDN and IMSI to subscribers and HLR, greatly reduces the administrative expenditures associated with replacing an SIM card (allocation of IMSI to HLR must be retained), in order to prevent virtual subscriber entries. Replacement of a large number of SIM cards is a regular occurrence. Likewise, when a new across-the-board service is introduced that requires new SIM cards, the SIM card must be replaced and

administrated for a correspondingly large number of subscribers. The expected percentage of resultant virtual subscriber entries is considerable.

International Roaming

Call Control does not generate any special requirements for the NAR in the case of international roaming, either.

Data Security and Privacy

No subscriber data such as supplementary services, call forwarding destinations or the like are stored on the NAR. The subscriber profile continues to remain in the HLR. Only the routing data are stored in the NAR, i.e., the information that describes the network element in which the subscriber data are located. Data security and privacy therefore do not generate any special requirements for the NAR.

Intelligent Network (IN)

Just as the subscriber data for GSM services are stored in the HLR, the subscriber data for the IN services of a subscriber are stored in the Service Control Point (SCP). If the network contains multiple SCP's, the object of the NAR in this case as well is to determine the SCP on which the data for a certain subscriber are stored. A distinction must be made between two basically different types of services, however: subscriber-specific services and network-wide services.

Subscriber-Specific Services

In the case of subscriber-specific services, the associated subscriber data must be available during the execution time in order for the IN service to be carried out

correctly. These subscriber-specific data are stored on the SCP. It can therefore be an object of the NAR to determine the SCP to which the service control should be handed over.
(INAP: InitialDP, service key, calling party number (MSISDN), IMSI, IMEI) for originating services.
(INAP: InitialDP, service key, called party number (MSISDN), IMSI, IMEI) for terminating services such as terminating call screening.

Network-Wide Services

The subscriber-specific data are insignificant for network-wide services. However, the SCP on which the service logics are implemented must be determined. The routing criterium for selecting the SCP is not the call number of the subscriber, however; it is the service key only.
(INAP: InitialDP, service key)

Local Number Portability (LNP)

When a customer in the fixed network changes his telecommunications carrier, he can retain his call number. The actual destination network of the called party can be determined in the call set-up phase itself by the source network (on-call inquiry). In this case, a data base in which the ported subscribers are registered is queried in the source network. Due to the expected high dynamic load generated by the data base queries, special requirements are placed on the performance of the data base. This LNP data base could be implemented in the NAR.

Mobile Number Portability (MNP)

ETSI is currently working to standardize MNP. It appears that there will be a choice of two variants for implementation. One variant is based on the MAP

protocol, and the other is based on the INAP protocol. When the standardization work is completed at ETSI, the requirements on the NAR in terms of Call Control, Mobility Management, and Supplementary Service Handling (e.g., for CCBS) are to be worked out.

Optimized Voice Mail Routing

For reasons of capacity, numerous Voice Mail Service Centers are in use in the mobile telephony network. Subscribers are currently allocated to the systems based on call number. A more economical system of allocation can be achieved if the location of the voice mail system is established as close as possible to the subscriber's most frequent location. This means a subscriber-specific system of allocation instead of block-wise allocation. The requirements on the NAR resulting from this are similar to those resulting from the HLR.

Equipment Identity Register (EIR)

If necessary, the NAR can use the IMEI to determine the EIR to which the inquiry must be sent. At this time, only the address of an EIR can be entered in the MSC. There is no plan to apportion the routing according to IMEI blocks. This would mean that all IMEI's would have to be stored in each EIR, which is not desirable in terms of data consistency. Routing to the respective EIR could be apportioned regionally. With one NAR in the network, routing could be implemented using the IMEI, so that just one part of the IMEI's reported as stolen would have to be stored. A potential data inconsistency can therefore be ruled out.
(MAP: Check-IMEI, IMEI)

Subscriber Administration

As an expansion of the functionality of the NAR, the ABC believes it should respond like a single HLR. All activations/changes are still sent to the NAR only, which then selects a suitable HLR and relays the message to the physical HLR.

The benefit of using the NAR as an HLR router is to be emphasized in particular. By introducing the NAR in the areas described above, many tasks can be solved more efficiently. The resultant cost savings exist in light of the additional expenditures that result from the introduction of a new network element, the NAR. In addition to the cost savings, an optimized capacity utilization of the respective network elements, such as the existing HLR's, also lead to savings in future investments for such network elements, such as HLR's.

Figures 1 through 11 show the method according to the invention based on various embodiments as an example in schematic diagrams. They are:

Figure 1 The method according to the invention used in the MSC/VLR → NAR → HLR message flow:

- Selection criterium MSISDN:
  - Mobile Terminating Call (MTC)
  - Supplementary Service Handling
- Selection criterium IMSI:
  - Location Update (inscription)

Figure 2 The method according to the invention used in the MSC → NAR → MSC → VMSC message flow:

- Selection criterium MSISDN:
  - Mobile Originating Call (VMSC inquiry)
  - Forwarded Call

Figure 3 The method according to the invention used in the VMSC → NAR → HLR message flow:

- Selection criterium MSISDN:
  - Supplementary Service Handling

Figure 4 The method according to the invention used in the MSC/VLR → NAR → SCP message flow:

- Selection criterium MSISDN:
  - Mobile Terminating Call (MTC)
  - Mobile Originating Call (MOC)
  - Supplementary Service Handling
- Selection criterium IMSI:
  - Location Update (inscription)
- Selection criterium IMEI:
  - Fraud Control

Figure 5 The method according to the invention used in the MSC/VLR → NAR → AUC message flow:

- Selection criterium IMSI:
  - Authentication

Figure 6 The method according to the invention used in the MSC/VLR → NAR → EIR message flow:

- Selection criterium IMEI:
  - IMEI Check
  - Fraud Control

Figure 7 The method according to the invention used in the HLR → NAR → SCP message flow:

- Selection criterium MSISDN:
  - Supplementary Service Handling
- Selection criterium IMSI:
  - Location Update

Figure 8 The method according to the invention used in the SMSC → NAR → HLR message flow:

- Selection criterium MSISDN:
  - Supplementary Service Handling

Figure 9 The method according to the invention used with Mobile Number Portability (MNP):

- Selection criterium MSISDN:
  - Mobile Terminating Call (MTC)
  - Supplementary Service Handling
- Selection criterium IMSI:
  - Location Update
  - Authentication
- Selection criterium IMEI:
  - IMEI Check
  - Fraud Control

Figure 10 The method according to the invention used with Local Number Portability (LNP):

- Selection criterium MSISDN:
  - PSTN Terminating Call (PTC)

and

Figure 11 A table containing all possible individual applications.

The various applications of the method based on the invention have been depicted in the drawing and described using common international terminology. Although the table shown in Figure 11 presents all individual applications, this is not intended to imply that all of the individual applications shown in Figure 11 must be implemented simultaneously in one telecommunications network, such as a fixed telephony network.

The various methods presented in Figures 1 through 10 can be used individually or in entirety in one single telecommunications network or in multiple mobile telephony networks, e.g., in two mobile telephony networks that correspond with each other, and/or in one or more mobile telephony networks in conjunction with one or more fixed networks.

The features described in the Abstract, Claims, and the Detailed Description, and presented in the diagram can also be essential individually or in random combinations to the implementation of the invention.

LIST OF ABBREVIATIONS

ABC	Administration and Billing Center
AuC	Authentication Center
BSS	Base Station Subsystem
CAP	CAMEL Application Part
CCBS	Call Completion to Busy Subscriber
CSC	Customer Service Center
DPC	Destination Point Code
DTAG	Deutsche Telekom AG
EIR	Equipment Identity Register
ETSI	European Telecommunications Standards Institute
GSMC	Gateway Mobile Services Switching Center
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
HLR	Home Location Register
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identity
IN	Intelligent Network
INAP	Intelligent Network Application Part
ISDN	Integrated Services Digital Network
LNP	Local Number Portability

MAP	Mobile Application Part
MD	Mediation Device
MNP	Mobile Number Portability
MOC	Mobile Originated Call
MSC	Mobile Services Switching Center
MSISDN	Mobile Station ISDN Number
MTP	Message Transfer Part
NAR	Network Address Register
NMC	Network Management Center
OMC	Operation and Maintenance Center
OPC	Originating Point Code
PSTN	Public Switched Telephone Network
SCCP	Signalling Connection Control Part
SCP	Service Control Point
SDF	Service Data Function
SIM	Subscriber Identity Module
SMS	Short Message Service
SMSC	Short Message Service Center
SSP	Service Switching Point
SPC	Signalling Point Code
STP	Signalling Transfer Point
TC	Transaction Capabilities
UMTS	Universal Mobile Telecommunications System

VASS	Value Added Services System
VLR	Visitor Location Register
VMSC	Voice Mail Service Center

Claims as amended

CLAIMS

1. Method for routing messages in at least one telecommunications network according to the GSM standard having one or more network elements with subscriber-specific data, characterized in that at least one Network Address Register (NAR) designed as an effective network element with routing data is arranged in the telecommunications network, which, while preventing the formation of blocks, individually determines a certain network element or multiple certain network elements (e.g., HLR, AUC, EIR, VMSC, SCP) using a subscriber-specific feature (e.g., MSISDN, IMSI, IMEI) and relays the respective message to it, or determines one or more network element addresses and returns these as routing information to the inquiry system, and this message is relayed by the inquiry system to the network element involved.

2. Procedure according to requirement, by the fact characterized that a GSM user recess yourself, whereby the MSC/VLR transmits the IMSI of the in-posting user to the NAR and on the basis the IMSI the address of the HLR determines the NAR, in whom the user data of the in-posting user are stored, whereupon the HLR answers direct to the testing MSC/VLR .

3. Procedures according to requirement 1 or 2, indicated the user data by it that the GSM user is called and the MSC/vlr transmits the call number of the GSM user (MSISDN) to the NAR and the NAR on the basis the MSISDNdie address of the HLR determined, in which are stored, and that the determined HLR answers direct then to the testing MSC/vlr.

4. Procedure according to requirement 1 or following requirements, by the fact characterized that a user tests its answering set (Voice mailbox), whereby the MSC transmits the MSISDN of the testing user to the NAR and on the basis the MSISDN the address of the VMSC determines the NAR and sends this address back to the testing MSC, whereupon the MSC structures the traffic channel to this VMSC, whereupon the Voice is hearable mailbox.

5. Procedure according to requirement 1 or following requirements, by the fact characterized that the VMSC transmits the call number of the GSM user (MSISDN) to the NAR, whereby the NAR determines the address of the HLR on the basis the MSISDN, in which the user data is stored, and which answers direct determined HLR then to the testing VMSC.

6. Procedure according to requirement 1, by the fact characterized that the MSC/vlr transmits the IMEI of the used portable radio device to the NAR, whereby the NAR further-ends the address of the SCP on the basis the IMEI determined and to the SCP.

7. Procedure according to requirement 1, by the fact characterized that with a beeches of the user the MSC/vlr the IMSI transmits to the NAR, whereby the NAR determines the appropriate SCP on the basis the IMSI and then to the SCP forwards the request and then to the MSC/vlr answers direct the SCP.

8. Procedure according to requirement 1, by the fact characterized that the MSC/vlr transmits the MSISDN of the called user to the NAR and the NAR on the basis the MSISDN determines the appropriate SCP and to this SCP forwards the request and to the NSC/vlr answers direct the SCP.

9. Procedure according to requirement 1, by the fact characterized that the MSC/vlr transmits the IMSI of the user to the NAR, who can be authenticated, and on the basis the IMSI the appropriate AUC determines the NAR and directly to this AUC forwards the request and the AUC answers direct to the MSC/vlr.

10. Procedure according to requirement 1, by the fact characterized that with a beeches of a user the HLR the IMSI transmits to the NAR and the NAR on on the basis the IMSI determines the appropriate SCP and passes to this SCP, which answers then the HLR.

11. Procedure according to requirement 1, by the fact characterized that during the rufumleitung the HLR transmits the MSISDN to the NAR and the NAR on the basis the MSISDN determines the appropriate SCP and to this SCP forwards the request and the SCP answers directly the testing HLR

12. Procedure after requirement 1, thereby characterized that the SMSC transmits the MSISDN to the NAR and on the basis the MSISDN the address of the HLR, in which the user data are stored determines the NAR, and which original message passes on to the determined HLR and which answers HLR directly the testing SMSC.

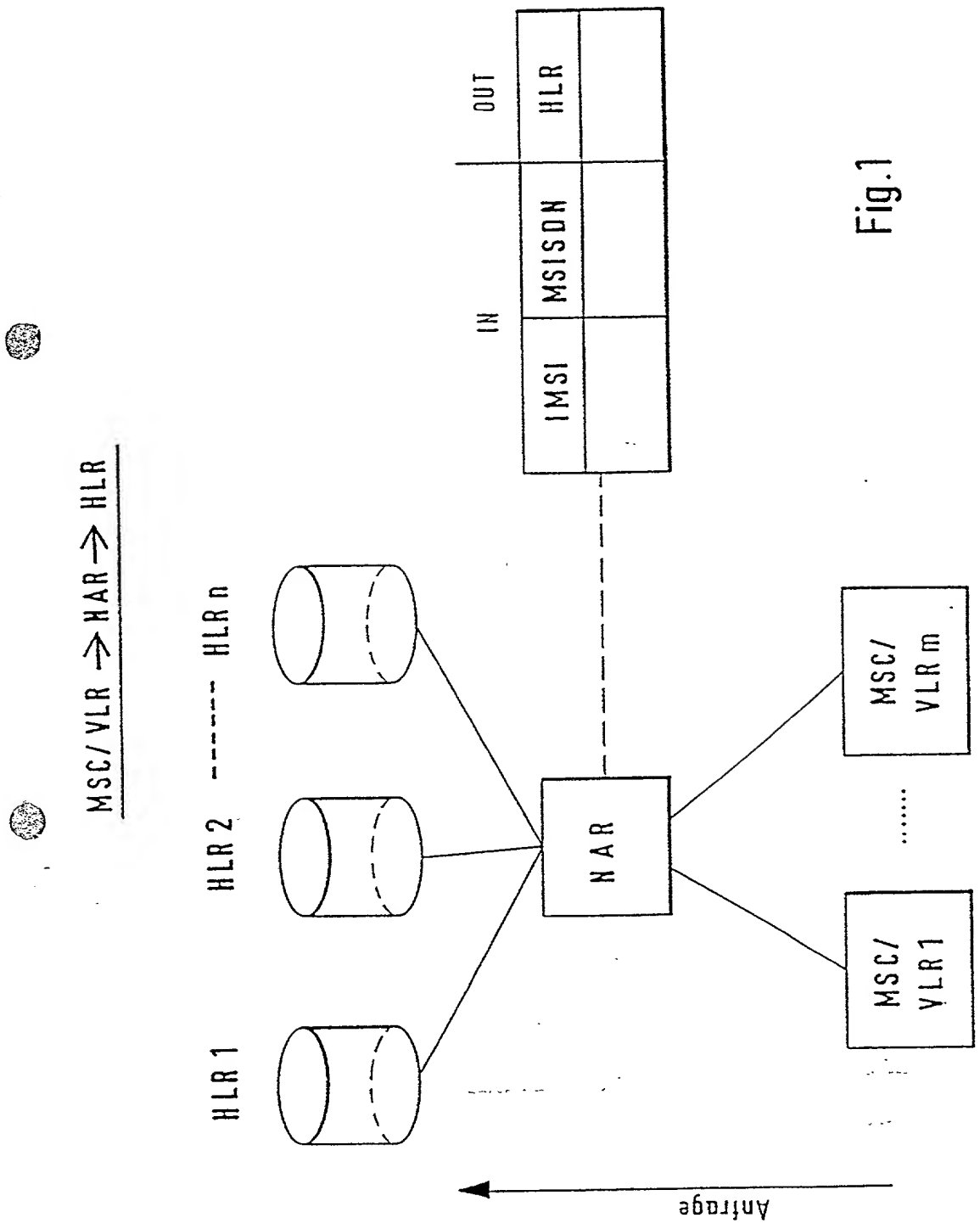
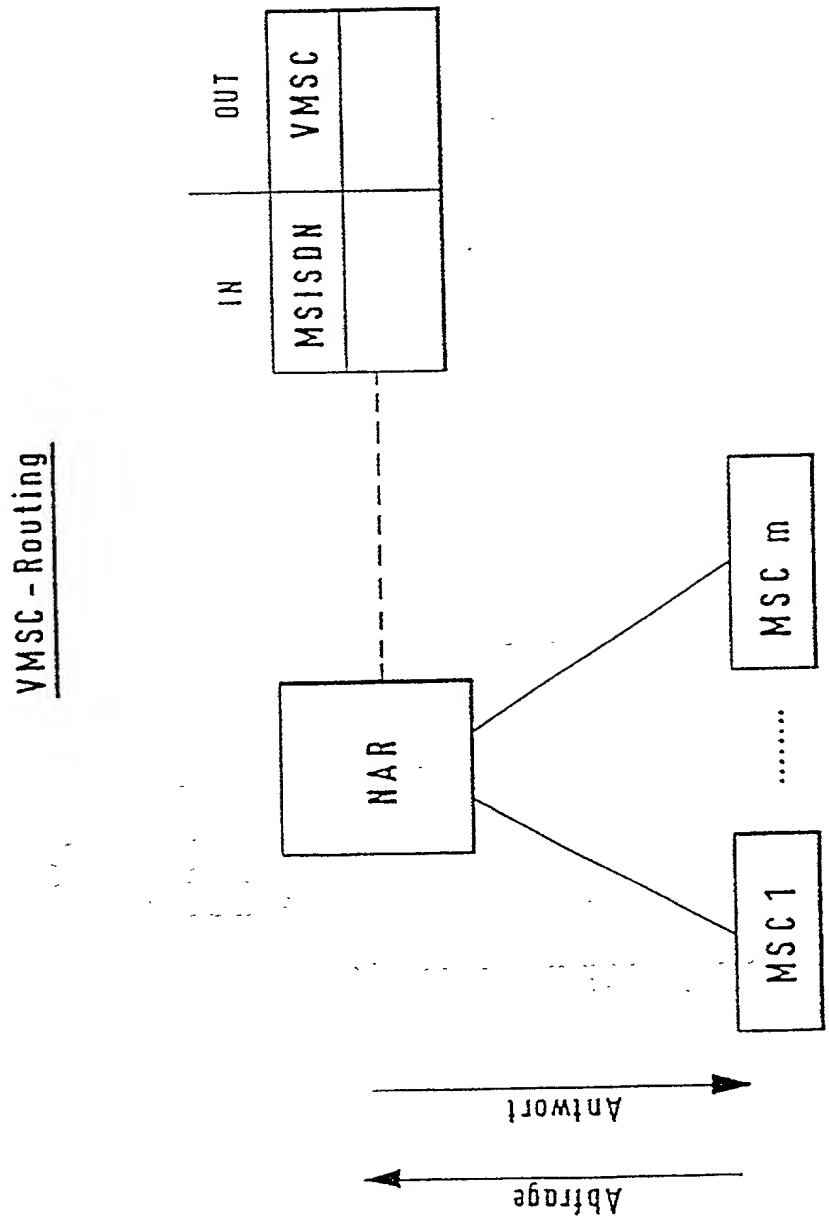

OUT
HLR
IN
MSISDN
IMSI
MSC/VLR → HAR → HLR
HLR n
HLR 2
HLR 1
HAR
MSC/ VLR m
MSC/ VLR 1
Anfrage

Fig.1

Fig. 2


VMSC - Routing
IN
MSISDN
OUT
VMSC
NAR
MSC 1
.....
MSC m
Abfrage
Antwort

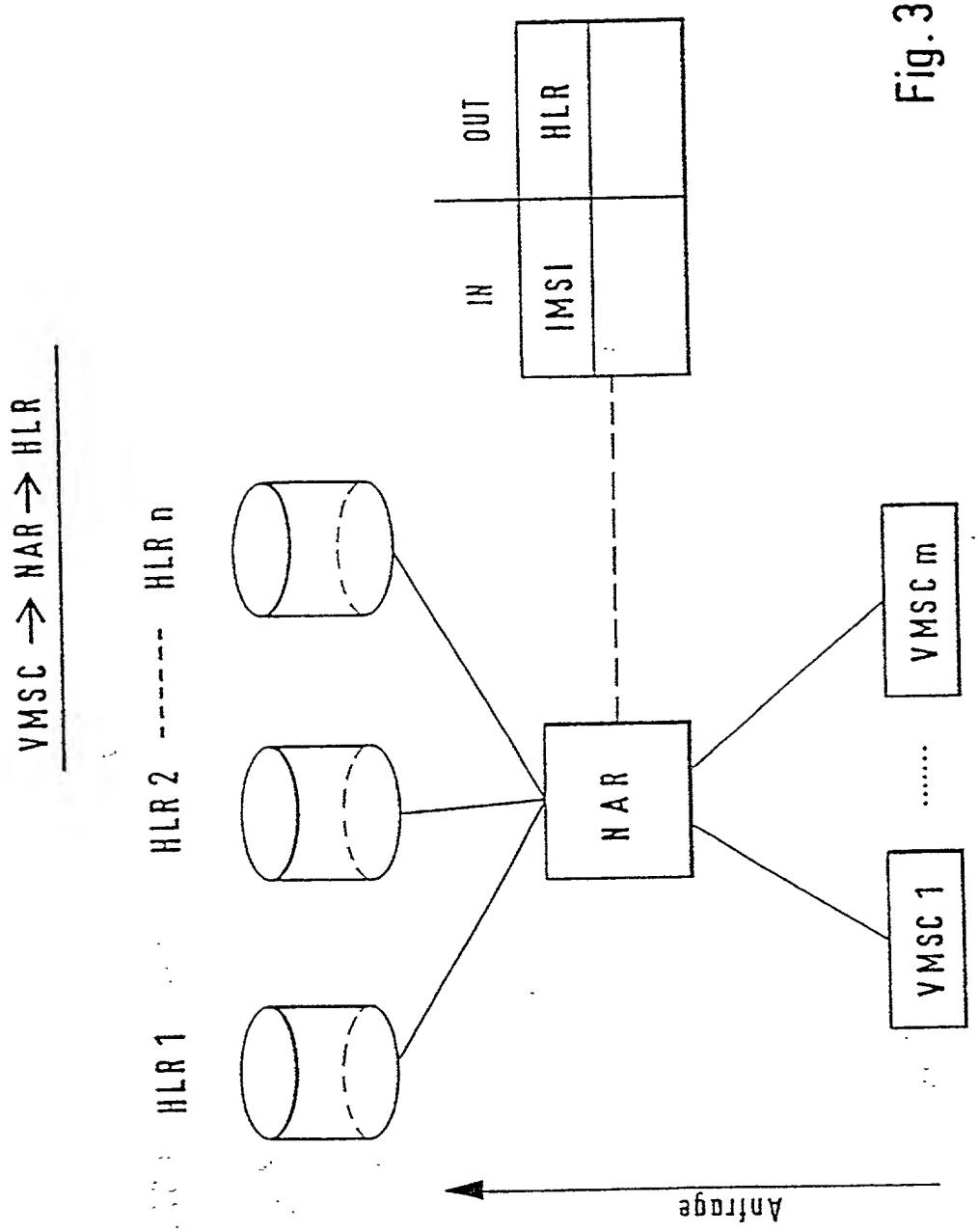

VMSC → NAR → HLR
HLR 1
HLR 2 ------ HLR n
NAR
VMSC 1
.....
VMSC m
IN
IMSI
OUT
HLR
Anfrage

Fig. 3

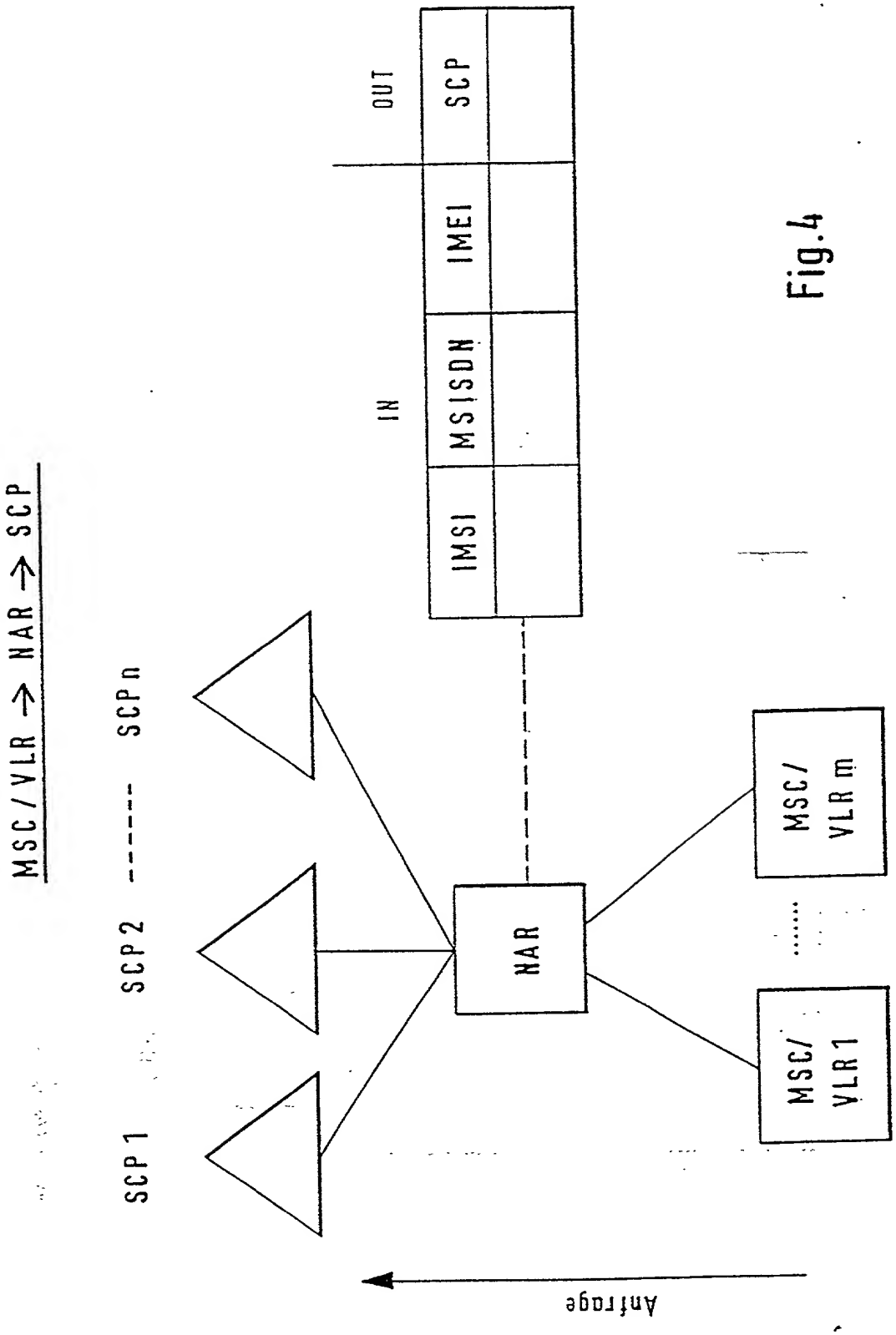
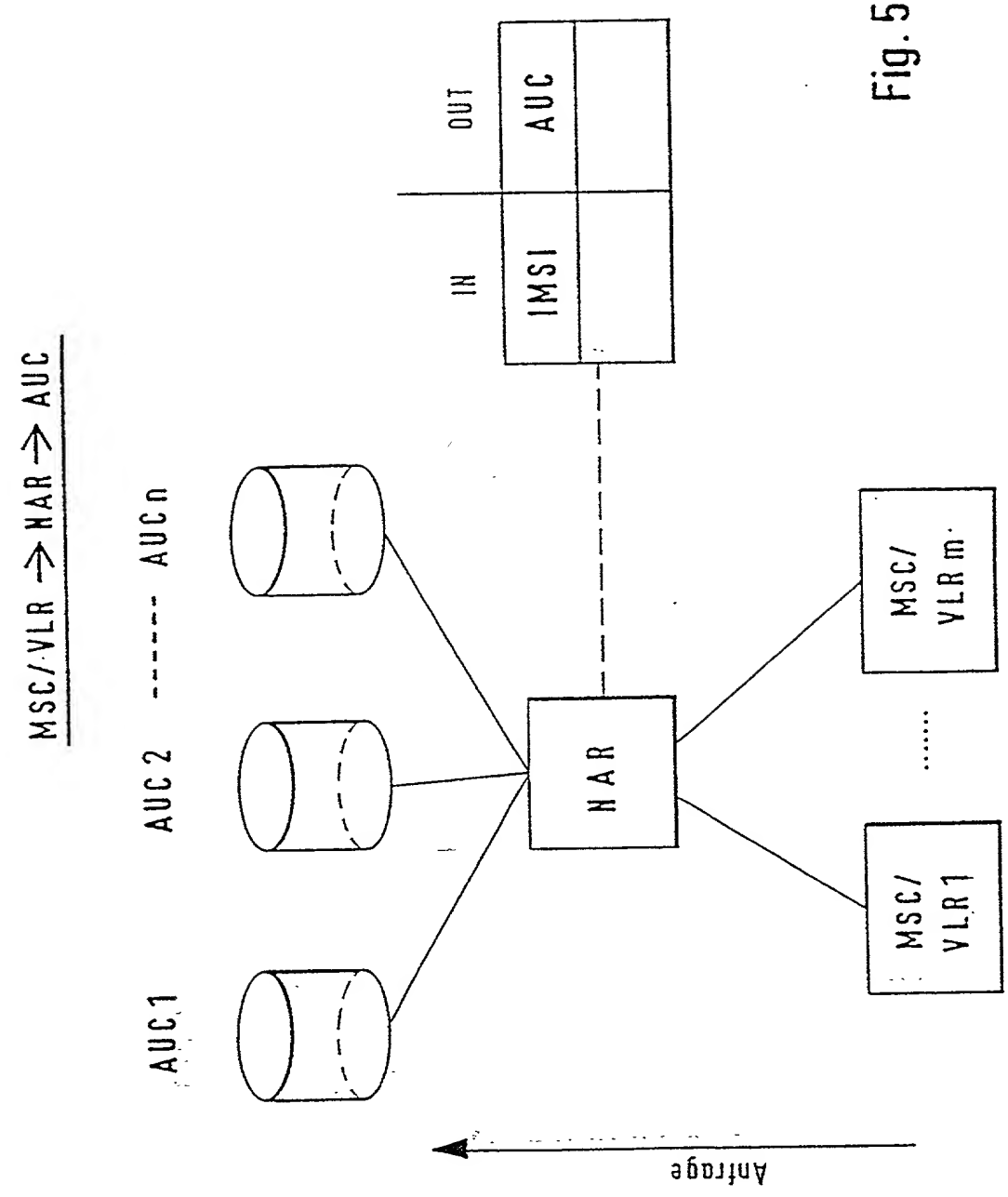

MSC / VLR → NAR → SCP
SCP 1
SCP 2
SCP n
NAR
MSC/ VLR 1
MSC/ VLR m
IN
IMSI
MSISDN
IMEI
OUT
SCP
Anfrage

Fig.4


MSC/VLR → NAR → AUC
OUT
AUC
IN
IMSI
AUC 2

AUC n
AUC 1
NAR
MSC/
VLR m
.....
MSC/
VLR 1
Antrage

Fig. 5

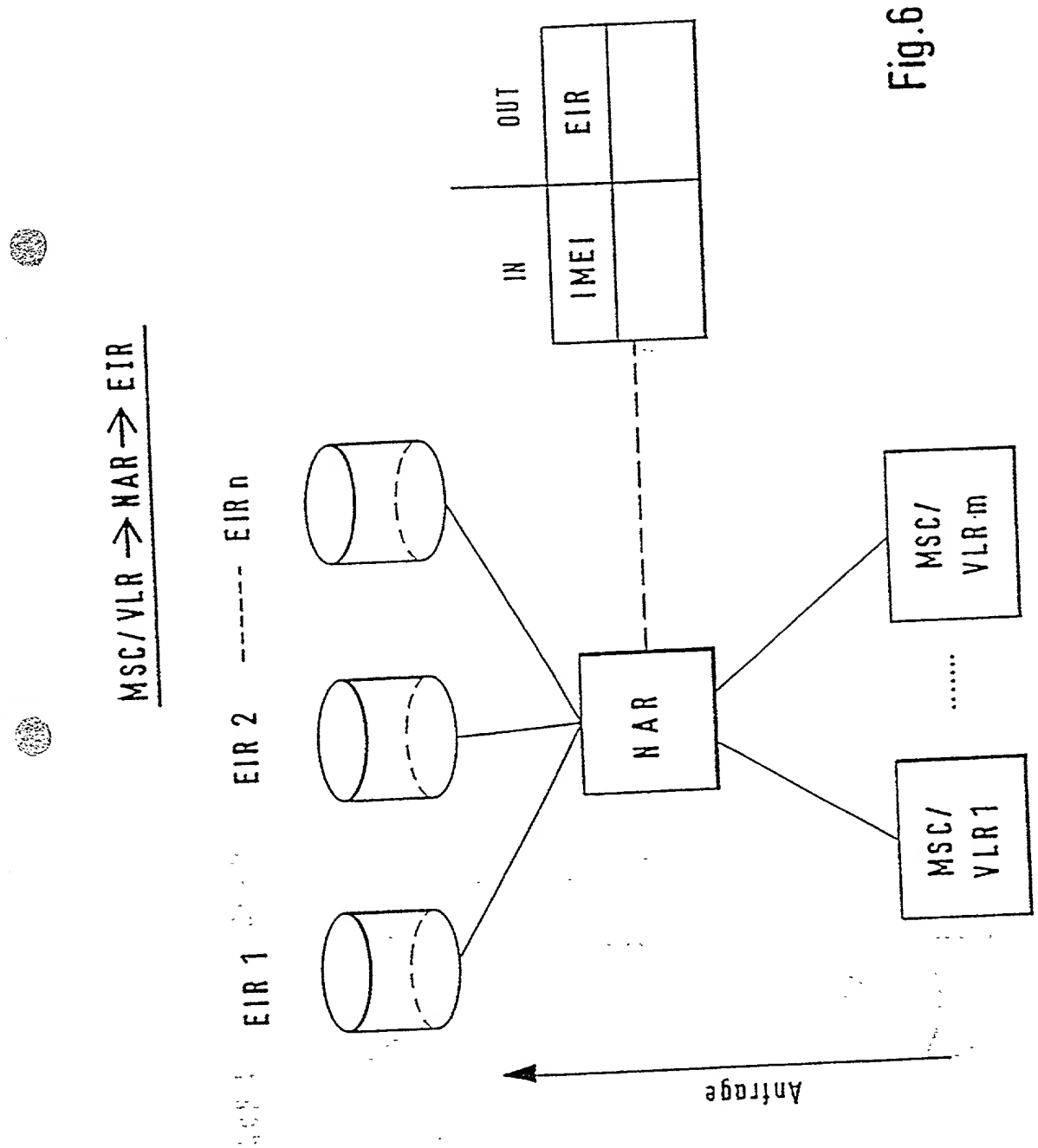

MSC/VLR → NAR → EIR
OUT
EIR
IN
IMEI
EIR n
EIR 2
EIR 1
NAR
MSC/ VLR m
MSC/ VLR 1
Antrage

Fig.6

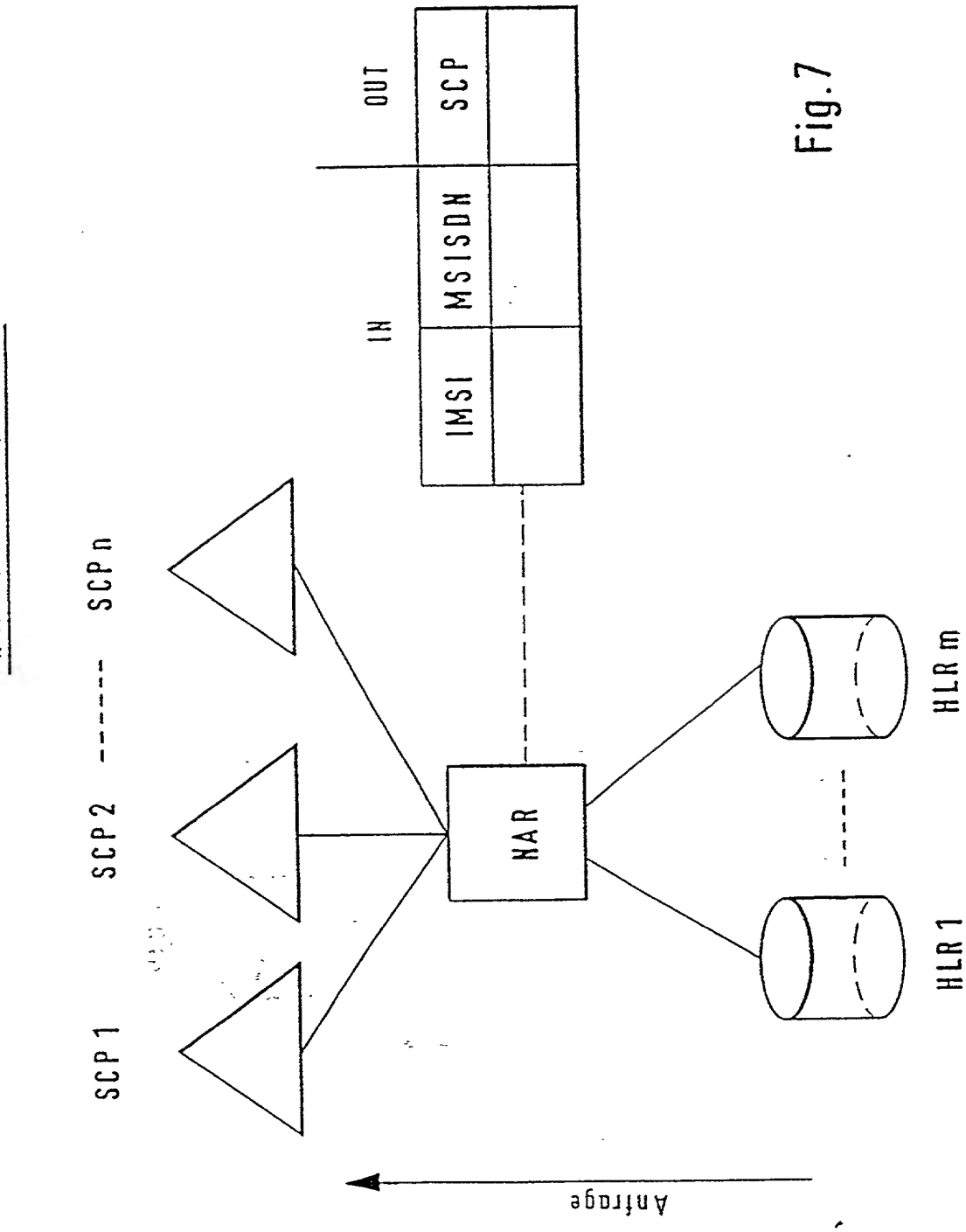

HLR → NAR → SCP
IN
IMSI
MSISDN
OUT
SCP
NAR
SCP 1
SCP 2
SCP n
HLR 1
HLR m
Anfrage

Fig.7

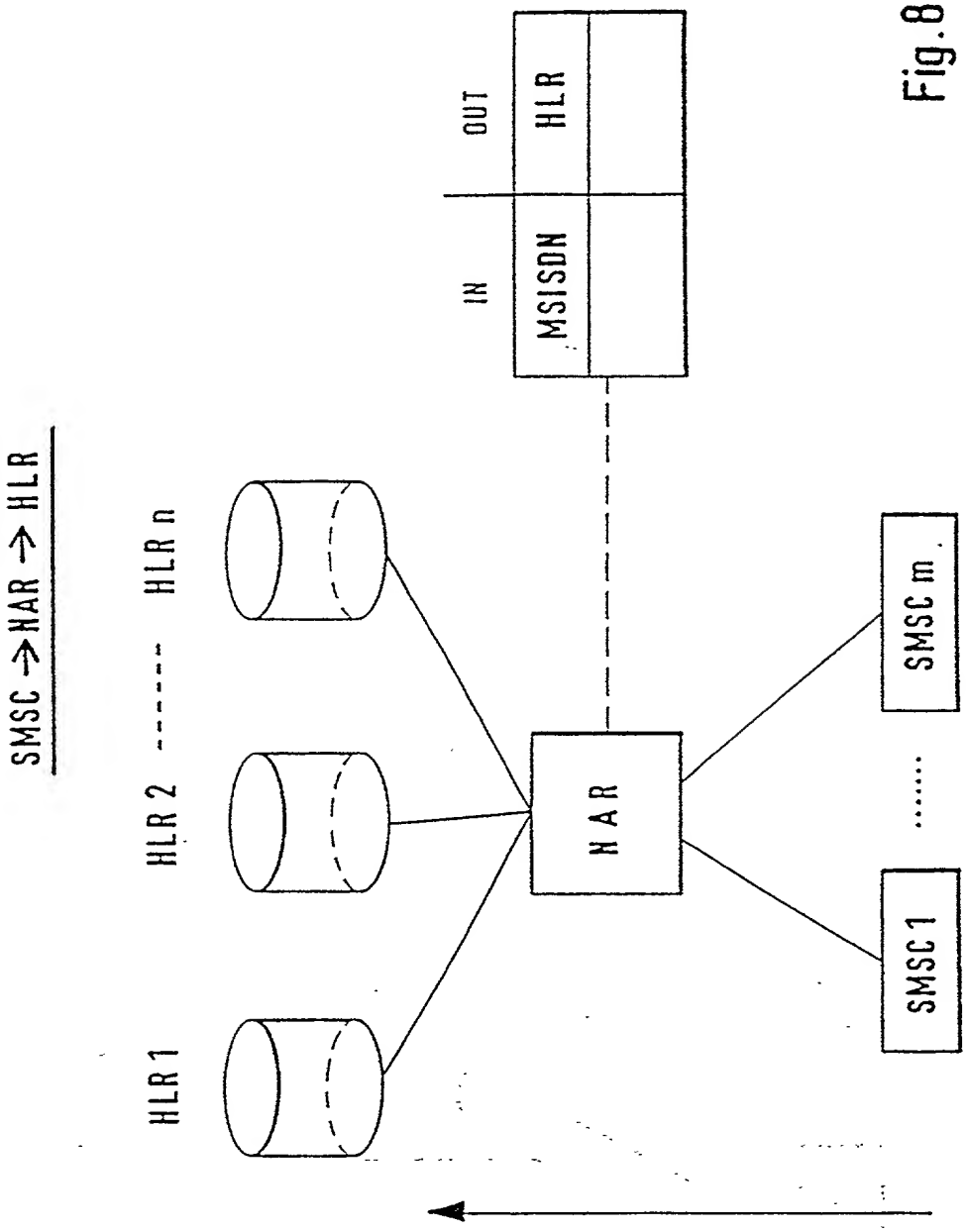


Fig.8

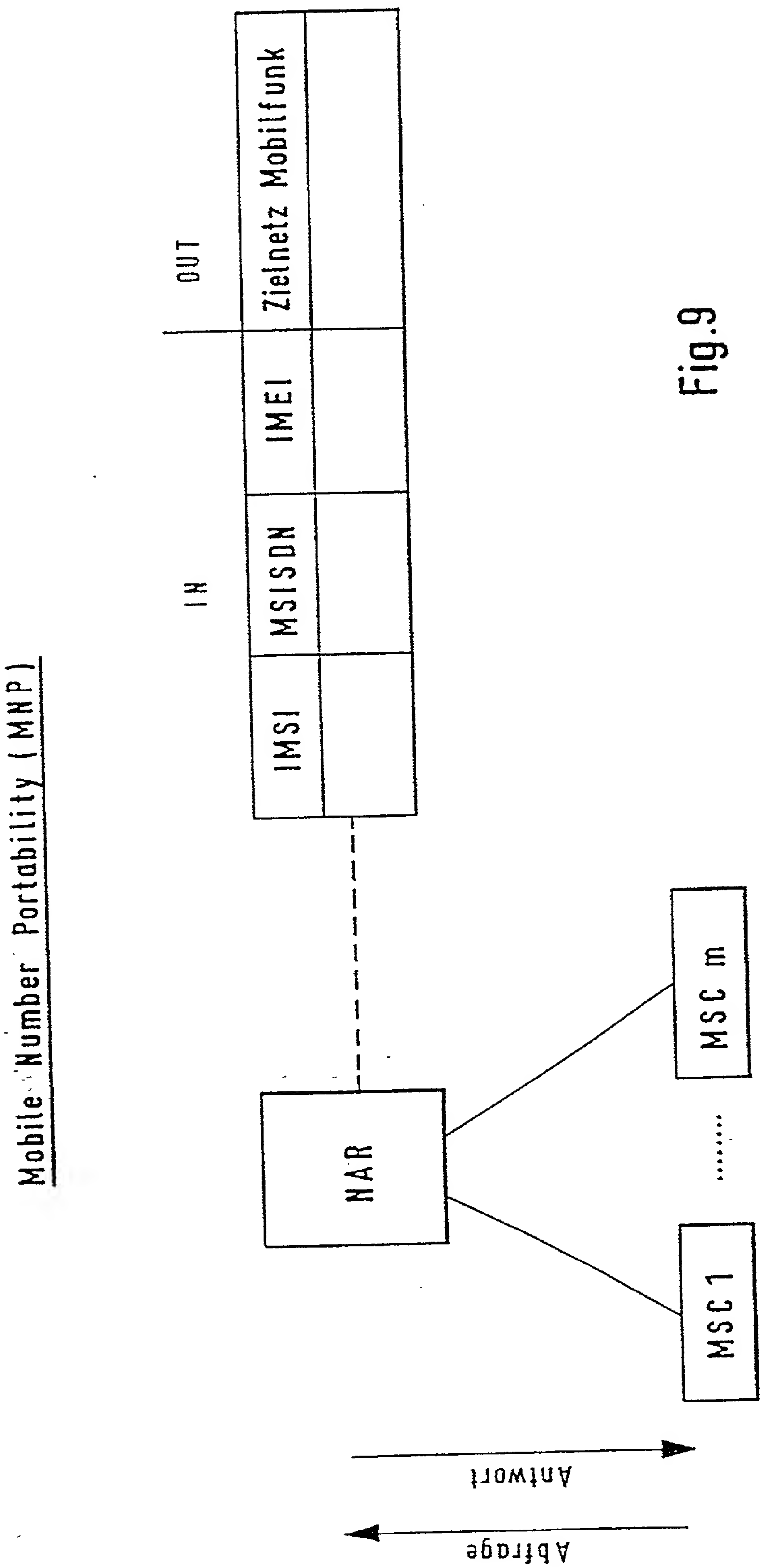

Mobile Number Portability (MNP)
IN
OUT
IMSI
MSISDN
IMEI
Zielnetz Mobilfunk
NAR
MSC m
MSC 1
Antwort
Abfrage

Fig.9

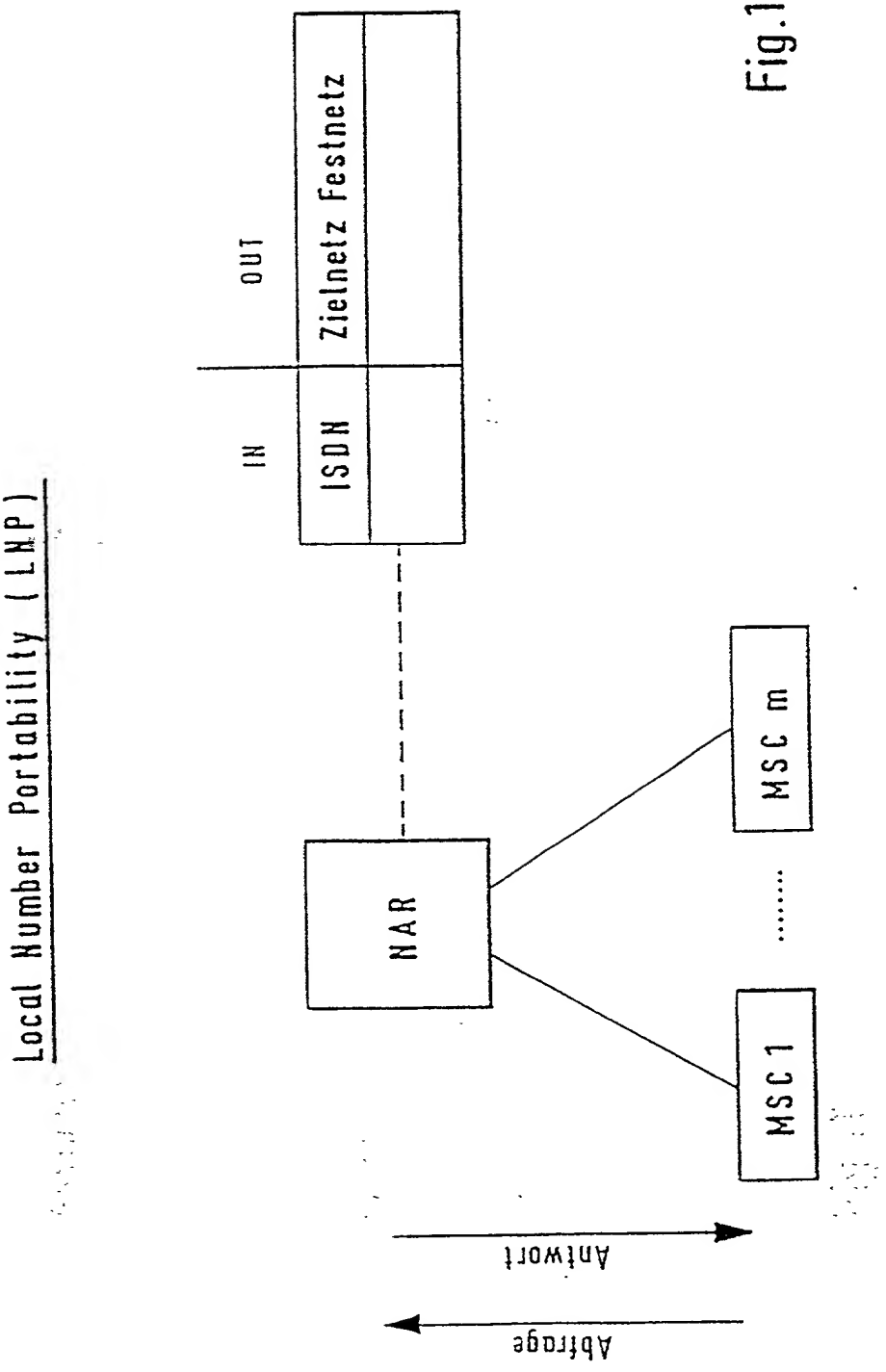

Local Number Portability (LNP)
IN
OUT
ISDN
Zielnetz Festnetz
NAR
MSC m
MSC 1
Antwort
Abfrage

Fig.10

Gesamttabelle für alle Einzelanwendungen

IN				OUT (Adressen der untenstehenden Netzelemente)				
MSISDN	IMSI	IMEI	ISDN	HLR	AUC	EIR	VMSC	SCP

OUT (Routingkennung für Netz)

Festnetz	Mobilnetz

Fig.11

Figure 1

[In the figure:]

German	**English**
Anfrage	Inquiry

Figure 2

[In the figure:]

German	**English**
Anfrage	Inquiry
Antwort	Response

Figure 3

[In the figure:]

German	**English**
Anfrage	Inquiry

Figure 4

[In the figure:]

German	**English**
Anfrage	Inquiry

Figure 5

[In the figure:]

German	**English**
Anfrage	Inquiry

Figure 6

[In the figure:]

German	**English**
Anfrage	Inquiry

Figure 7

[In the figure:]

German	**English**
Anfrage	Inquiry

Figure 8

Figure 9

[In the figure:]

German	**English**
Anfrage	Inquiry
Antwort	Response
Zielnetz Mobilfunk	Destination Network Mobile Telephony

Figure 10

[In the figure:]

German	**English**
Anfrage	Inquiry
Antwort	Response
Zielnetz Festnetz	Destination Network Fixed Network

Figure 11

TABLE LISTING ALL INDIVIDUAL APPLICATIONS

[In the figure:]

German	**English**
Adressen der untenstehenden Netzelemente	Addresses of the network elements listed below
Routingkennung für Netz	Routing station identification for the network
Festnetz	Fixed network
Mobilnetz	Mobile network

SUBSTITUTE SPECIFICATION

METHOD FOR ROUTING MESSAGES IN AT LEAST ONE TELECOMMUNICATIONS NETWORK ACCORDING TO THE GSM STANDARD

REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of PCT patent application WO 00/38458, filed on June 29, 2000, titled "Method For Routing Messages In At Least One Telecommunications Network According To The GSM Standard."

BACKGROUND

[0002] This invention relates generally to the field of mobile communication and more specifically to mobile communication system that uses a NAR.

[0003] In conventional cellular GSM mobile telephony networks, subscriber data for a mobile telephone subscriber is maintained in a central data base, called the Home Location Register ("HLR"). As the number of subscribers and thus the need for calling numbers increases, the planning required for organizing the HLR, Subscriber Identity Module ("SIM") card, and Voice Mail Service Center ("VMSC") become considerably more complex. The added complexity is due in part to the need to form blocks of calling numbers and distribute them to the HLRs and VMSCs. The system planning is made more difficult due to special-request call numbers. Further complexity is added by the formation of blocks for Mobile Station ISDN Number ("MSISDN") and the International Mobile Subscriber Identity ("IMSI"). Due to the system limitations of the HLR, mobile telephony networks with many subscribers typically have multiple HLRs. The determination of which HLR stores data for which subscriber is determined as a function of the calling numbers of the mobile telephone subscriber or the subscriber's IMSI. The determination of which

subscriber data is on which HLR is part of the network design. Other network elements also contain subscriber-specific data including the Service Control Points ("SCP") with integrated Service Data Function ("SDF") and the Voice Mail Centers ("VMSC") that provide centralized answering services.

[0004] Since GSM subscriber data is stored in the HLRs and each subscriber is identified by an MSISDN or an IMSI, the Mobile Services Switching Centers ("MSC") and the Visitor Location Register ("VLR") must be able to determine the subscriber's HLR based solely on an MSISDN or an IMSI. Due to capacity and administrative limits, all individual calling numbers and IMSIs cannot be stored in the MSCs routing tables. The MSISDN is used for Mobile Terminating Calls ("MTC") and the IMSI is used for location updates. The call routing is defined by the MSC. Since an individual IMSI of an international subscriber is programmed in the SIM cards, the combination of SIM card and calling number must match when the subscriber is activated and they must be assigned to the same HLR. If this is not the case, a virtual subscriber entry is created in the HLR, which may have limited capacity available. Subscriber distribution to HLRs becomes increasingly more difficult as the number of subscribers and/or HLRs increases. The capacity of the HLRs will be further drained as additional network identification numbers are added.

[0005] Some customers request a specific calling number (telephone number"). Allocating calling numbers to specific customers complicates the configuration of the MSCs and distribution of the calling numbers to the existing HLR. When the calling number space available for activation is already set up, allocating a specific calling number to a customer is even more difficult.

[0006] HLR splits commonly occur when a new HLR is put into service. Calling number and IMSI ranges are assigned to the new HLR so that subscribers can be activated in this new HLR. Such assignments are characterized during HLR roll-out similarly to calling number allocation and numbering planning by the Voice Mail Service Center ("VMSC"). Thus, adding a new HLR requires an immense amount of planning and is highly susceptibility for errors. HLR capacity is often wasted as a result.

[0007] Similar considerations as those posed in conjunction with adding an HLR can also result for other network elements having subscriber-specific data. For example, the subscriber data for Intelligent Network ("IN") services of a subscriber are stored in the Service Control Point ("SCP").

[0008] The global system for mobile communications ("GSM") standard is well known. The GSM standard § 03.02 (ETS 300.522) concerns European digital telecommunications system (Phase 2). The European Telecommunications Standard of Institutes ("ETSI") defines a network architecture for GSM network, including digital cellular telecommunications system. The GSM standard section § 03.04 (ETS 300.524) concerns the signaling requirement relating to routing of calls to mobile subscribers in the European digital cellular telecommunications system (Phase 2). The GSM standard 09.02 (ETS 300.599) further describes the European digital cellular telecommunications system (phase 2). The Mobile Application Part ("MAP") specification describes the ETSI returns. The GSM standard § 03.12 (ETS 300,530) describes location registration procedures on the ETSI returns in the European digital cellular telecommunications system (phase 2);.

SUMMARY

[0009] A Network Address Register ("NAR"), a routing device, assigns mobile network subscribers individually to the network elements. The NAR may be used in a mobile telephone network, for example a cellular telephone network, to eliminate the requirement of formation of blocks of telephone numbers (calling numbers). The need to distribute the calling numbers to the various network, such as the HLRs, is also eliminated. The improved system also eliminates the need for virtual HLR entries and the errors associated with virtual HLR entries. Eliminating these needs provides better capacity utilization of existing network elements.

[00010] Due to the better capacity utilization, A network with the NAR may eliminate the need for some network elements. Thus reducing cost and complexity. Additional savings may be realized in the areas of calling numbering planning, calling number administration, and SIM card distribution. The NAR may be used with existing services, network elements, and functions provided in conventional telecommunications networks. The NAR may also be used with other applications including applications implementing the Mobile Number Portability ("MNP") standard. The NAR software may also be adaptable to various application-specific requirements.

[00011] The NAR may route messages to the appropriate network elements, for example MAP Send-Routing-Information to the HLR. Alternatively, the NAR may determine a network element address and return the routing information to the inquiring system. For example, the routing information may include INAP: initial DP + Connect. The inquiring system can then relay the message.

[00012] The foregoing discussion has been provided only by way of introduction. Nothing in this section should be taken as a limitation on the following claims, which define the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[00013] The components in the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention. Moreover, in the figures, like reference numerals designate corresponding parts throughout the different views.

[00014] FIGURE 1 illustrates an embodiment of a telephone system with a NAR that routes messages to HLRs; and

[00015] FIGURE 2 illustrates an embodiment of a telephone system with a NAR that routes messages to VMSCs via MSCs via a NAR.

[00016] FIGURE 3 illustrates an embodiment of a telephone system with a NAR that routes messages to HLRs from VMSCs via a NAR.

[00017] FIGURE 4 illustrates an embodiment of a telephone system with a NAR that routes messages to HLRs from MSCs via a NAR.

[00018] FIGURE 5 illustrates an embodiment of a telephone system with a NAR that routes messages to AUC from MSCs/VLRs via a NAR.

[00019] FIGURE 6 illustrates an embodiment of a telephone system with a NAR that routes messages to SCP from HLRs via a NAR.

[00020] FIGURE 7 illustrates a method of routing messages to HLRs from SMSCs via a NAR.

[00021] FIGURE 8 illustrates a system with a NAR as central message distributors.

[00022] FIGURE 9 illustrates a system with a NAR in the telephone network.

[00023] FIGURE 10 illustrates a system with a NAR in the telephone network.

[00024] FIGURE 11 illustrates a transit and final function of NAR.

[00025] FIGURE 12 illustrates a information flow VLR, NAR and HLR.

[00026] FIGURE 13 illustrates a NAR as HLR-Router (in the GSM-Network).

[00027] FIGURE 14 illustrates a telecommunication system with a NAR as a router.

DETAILED DESCRIPTION

A. DEFINITIONS

[00028] ABC - Administration and Billing Center

[00029] AuC - Authentication Center

[00030] ADC - Administration system

[00031] BSS - Base Station Subsystem

[00032] Calling number - The telephone number of the call originator.

[00033] Called number - The called telephone number.

[00034] CAP - CAMEL Application Part

[00035] CCBS - Call Completion to Busy Subscriber

[00036] CSC - Customer Service Center

[00037] DPC - Destination Point Code

[00038] DTAG - Deutsche Telekom AG

[00039] EIR - Equipment Identity Register

[00040] ETSI - European Telecommunications Standards Institute

[00041] GSMC - Gateway Mobile Services Switching Center

[00042] GPRS - General Packet Radio Service

[00043] GSM - Global System for Mobile Communications

[00044] HLR - Home Location Register

[00045] HPLMN - Home Public Land Mobile Network

[00046] IDP - Initial Detection Point

[00047] IMEI - International Mobile Equipment Identity

[00048] IMSI - International Mobile Subscriber Identity

[00049] IN - Intelligent Network

[00050] INAP - Intelligent Network Application Part

[00051] ISDN - Integrated Services Digital Network

[00052] LNP - Local Number Portability

[00053] LUP - Location Update Procedure

[00054] MAP - Mobile Application Part

[00055] MAPv1 - MAP version 1

[00056] MAPv2 - MAP version 2

[00057] MD - Mediation Device

[00058] MNP - Mobile Number Portability

[00059] MOC - Mobile Originated Call

[00060] MSC - Mobile Services Switching Center

[00061] MSISDN - Mobile Station ISDN Number

[00062] MTC - Mobile Terminating Calls

[00063] MTP - Message Transfer Part

[00064] NAR - Network Address Register

[00065] NMC - Network Management Center

[00066] OMC - Operation and Maintenance Center

[00067] OPC - Originating Point Code

[00068] PSTN - Public Switched Telephone Network

[00069] SCCP - Signaling Connection Control Part

[00070] SCP - Service Control Point

[00071] SDF - Service Data Function

[00072] SIM - Subscriber Identity Module

[00073] SIM card - a SIM card is used for billing, security and number storage.

The SIM card parameters are defined by ISO GSM SIM Card standards.

[00074] SMS - Short Message Service

[00075] SMSC - Short Message Service Center

[00076] SSP - Service Switching Point

[00077] SPC - Signaling Point Code

[00078] SRI - Send Routing information

[00079] STP - Signaling Transfer Point

[00080] TC - Transaction Capabilities

[00081] UMTS - Universal Mobile Telecommunications System

[00082] VASS - Value Added Services System

[00083] VLR - Visitor Location Register

[00084] VMSC - Voice Mail Service Center

B. INTRODUCTION

[00085] The following description of the preferred embodiments of the invention is not intended to limit the scope of the invention to these preferred embodiments, but rather to enable any person skilled in the art to make and use the invention.

[00086] The NAR is an active effective network element that allocates which physical network element contains the subscriber-specific data. For example, the NAR may determine that the subscriber data records for a first subscriber by located on a first HLR and the subscriber data records for a second subscriber by located on a second HLR. The NAR, therefore, should be a highly reliability. If an NAR becomes unavailable, for example due to a failure of all network elements in a conventional GSM network. Also, if a NAR becomes unavailable, some value-added services and mobility management may be seriously impaired. For these reasons, the network architecture must provide a high degree of security. Therefore redundant NAR in the network configuration may be used.

[00087] The HLR planning may be isolated from call-number allocation and SIM card requests. The generation of the system characteristics may be isolated from MSISDN/IMSI distribution. The quality of the network is improved by eliminating virtual subscriber entries.

[00088] The various applications of the method based on the invention have been depicted in the drawing and described using common international terminology. This is not intended to imply that all of the individual applications must be implemented simultaneously in one telecommunications network, such as a fixed telephony network.

[00089] The design benefits of a telephone system having a NAR includes: 1. allocation of IMSI/MSISDN ranges to HLR is eliminated; 2. HLR planning is separated from call-number allocations and SIM card production; 3. representation of system characteristics in the MSC is separated from MSISDN/IMSI distribution; and 3. network quality is improved due to the elimination of virtual subscribers, which are often results in errors.

C. NAR-based Network

[00090] Figures 1-14 illustrate schematic diagrams of various embodiments of NAR-based networks and message flows. The various systems and methods presented in Figures 1 through 14 can be used individually, in a single telecommunication network, or in multiple mobile telecommunication networks, e.g. in two interconnected mobile telephony networks, and/or in one or more mobile telephony networks in conjunction with one or more fixed networks.

[00091] Referring to Figure 1, an embodiment of a telephone system 100 with a NAR 108 that routes messages 150 from MSC/VLRs 110 and 112 to HLRs 102, 104, and 106 is illustrated. An inquiry message 150 from a first MSC 110 or a first VLR 110 is received by the NAR 108. The inquiry message 150 may include the IMSI and the MSISDN. The NAR 108 determines the HLR, for example HLR1 102 that corresponds with the IMSI and the MSISDN in the inquiry message 150. The NAR 108 may use a database, a buffer, or other method to store the Data 120 that is used to determined the HLR that corresponds to the IMSI and the MSISDN. The Data 120 may include a routing database.

[00092] Referring to Figure 2, an embodiment of a telephone system 200 with a NAR 210 that routes messages from a VMSC 204 via a MSC 202 and a NAR 210

is illustrated. The NAR 210 determines the appropriate VMSC based on the MSISDN of the inquiring mobile station. The relationships between MSISDNs and VMSCs may be stored in a database, a buffer, or other storage device represented by Data 208. The selection criterion for the MSISDN may include a mobile originating call ("MOC") in the VMSC inquiry and the forwarded call. A NAR 210 may communicate with numerous VMSCs via one or more MSCs 202 and 206.

[00093] Referring to Figure 3, an embodiment of a telephone system 300 with a NAR 308 that routes messages 350 to HLRs 302, 304, and 306 from VMSCs 310 and 312 via a NAR 308 is illustrated. The NAR 308 determines the appropriate HLR based on the MSISDN. The relationships between MSISDNs and HLRs may be stored in a database, a buffer, or other storage device represented by Data 320. The selection criterion for the MSISDN may include supplementary service handling.

[00094] Referring to Figure 4, an embodiment of a telephone system 400 with a NAR 408 that routes messages to SCPs 402, 404, and 406 from MSCs or VLRs 410 and 412 is illustrated. The NAR 408 determines the appropriate SCP based on the IMSI, MSISDN, and/or IMEI in the message. The relationships between IMSIs, MSISDNs, IMEIs, and SCPs may be stored in a database, a buffer, or other storage device represented by Data 420. The selection criterion for the IMSI may include location update ("inscription") and authentication. The selection criterion for the MSISDN my include mobile terminating call ("MTC"), mobile originating call ("MOC"), and supplementary service handling. The selection criterion for the IMEI my include IMEI check and fraud control.

[00095] Referring to Figure 5, an embodiment of a telephone system 500 with a NAR 508 that routes messages 550 to AUC 502, 504, and 506 from MSCs/VLRs

510 and 512 is illustrated. The NAR 508 may determine the appropriate AUC based on the IMSI in the message. The relationships between IMSIs and AUCs may be stored in a database, a buffer, or other storage device represented by Data 520. The selection criterion for the IMSI may include authentication.

[00096] Referring to Figure 6, an embodiment of a telephone system 600 with a NAR 608 that routes messages to SCPs 602, 604, and 606 from HLRs 610 and 612 is illustrated. The NAR 608 may determine the appropriate SCP based on the IMSI and the MSISDN in the message. The relationships between IMSIs, MSISDNs, and the AUCs may be stored in a database, a buffer, or other storage device represented by Data 620. The selection criterion for the MSISDN may include supplementary service handling. The selection criterion for the Selection criterion for the IMSI includes Location Update.

[00097] Referring to Figure 6, the message flow from the MSC/VLR to an EIR via a NAR is illustrated. The selection criterion for the IMEI includes IMEI Check and Fraud Control.

[00098] Referring to Figure 7, an embodiment of a telephone system 700 with a NAR 708 that routes messages 750 from SMSCs 710 and 712 to HLRs 702, 704, and 706 is illustrated. The NAR 708 may determine the appropriate HLR based on the MSISDN in the message. The relationships between MSISDNs and AUCs may be stored in a database, a buffer, or other storage device represented by Data 720. The selection criterion for the MSISDN may include supplementary service handling.

[00099] Referring to Figure 8, a system 800 with a NAR 808 as central message distributors is illustrated. The message 802 is routed by the NAR 808 to

the appropriate SCP 810, HLR 812, or VMSC 814. The NAR 808 may include a centralize message buffer.

[000100] Referring to Figure 9, a telephone network (mobile signaling network) 900 with a NAR 908 is illustrated. The telephone network 900 may include a GSM telecommunication network. The NAR 908 is used in the signaling portion of the telephone network 900 and not the switched portion. Thus, no traffic channels are carried by the NAR. a method of using Mobile Number Portability ("MNP") is illustrated. The telephone network 900 with a NAR 908 has greater flexibility than conventional networks in all elements that refer to subscriber-specific data, such as SCP 902, SMSC 904, HLRs 906, EIR 910, MSCs/VLRs 912 and 914, VMSC 916, and VE:ns 918.

[000101] Referring to Figure 10, illustrates a transit function of the NAR 1008 in the telephone network 1000. The NAR 1008 routes a messages from the MSC/VLR 1014 to the HLR 1102. The NAR 1008 may provide local number portability ("LNP"). The NAR 1008 may route the message based in part on the MSISDN. The selection criterion for the MSISDN may include the PSTN Terminating Call ("PTC").

[000102] Referring to Figure 11, illustrates a transit function of the NAR 1108 in the telephone network 1100. The NAR 1108 routes a messages from the MSC/VLR 1014 to the VMSC 1104.

[000103] Referring to Figure 12, a "location update" flow from a VLR 1202 to a HLR 1206 is via a NAR 1204 is illustrated. The VLR 1202 send a message "1:LUP" to the NAR 1204. The NAR 1204 routes the message "2:LUP" to the appropriate

HLR 1206. The HLR 1206 then sends an acknowledgement message "3:LUP ack" to the originating VLR 1202.

[000104] Referring to Figure 13, a NAR 1310 is used as a HLR-Router in a GSM based network 1300. A NAR-based network 1300 implements a different routing principle in a telecommunications network, e.g. a mobile telephony network, than conventional networks. In a NAR-based network 1300 subscriber-specific allocation of MSISDNs 1314 and IMSIs 1312 to the HLRs 1302, 1304, 1306, and 1308 are defined. The NAR 1308 may include a database with the allocations that are used when inquiries are sent to the HLR 1302, 1304, 1306, and 1308. The routing criteria may be the MSISDN and the IMSI.

[000105] Referring to Figure 14, a telecommunication system 1400 with a NAR 1408 as a router is illustrated. The NAR 1408 may be integrated into a conventional GSM network that includes network elements, such as SCPs 1402, SMSCs 1404, HLRs 1406, BSSs 1412, MSC/VLRs 1414, VMSCs 1416, an EIR 1410, and an ABC 1418. The GSM network may be an intelligent network ("IN"). Also, value-added services network elements, such as short-message service and automatic answering, may be included in the system.

D. Network Elements Addressing

[000106] The addressing in the individual network elements may be carried out as follows:

[000107] I. Subscriber's IMSI-based addressing:

[000108] 1: VLR:

[000109] MTP: The DPC is the SPC of the NAR, the OPC is the SPC of the VLR.

[000110] SCCP: The called party number is the "IMSI" (E.214; E.212) and the calling party number is the VLR address (E.164)

[000111] The Global Title Analysis is set up in the VLR in such a way that the SPC of the NAR is used as the DPC.

[000112] 2. NAR:

[000113] MTP: The DPC is the SPC of the HLR, the OPC is the SPC of the NAR.

[000114] SCCP: The called party number is the "IMSI" (E.214; and possibly E.212) and the calling party number is the VLR address (E.164)

[000115] A Global Title Translation is carried out in the NAR, the result of which is the SPC of the HLR, which is used as the new DPC.

[000116] 3. HLR: MTP: DPC = SPC of the VLR, OPC = SPC of the HLR

[000117] SCCP: The called party number is the VLR address (E.164) and the calling party number is the HLR address (E.164).

[000118] These addressing mechanisms are comparable to existing mechanisms in GSM mobile telephony networks.

[000119] Addressing based on the MSISDN of the subscriber:

[000120] 1. VLR:

[000121] MTP: The DPC is the SPC of the NAR, the OPC is the SPC of the VLR. SCCP: The called party number is the MSISDN (E.164). The calling party number is the VLR address (E.164).

[000122] The Global Title Analysis is set up in the VLR in such a way that the SPC of the NAR is always used as the DPC.

[000123] 2. NAR:

[000124] MTP: The DPC is the SPC of the HLR, the OPC is the SPC of the NAR. SCCP: The called party number is the MSISDN (E. 164). The calling party number is the VLR address (E.164).

[000125] A Global Title Translation may be carried out in the NAR that results in the SPC of the HLR to be used as the new DPC.

[000126] 3. HLR:

[000127] MTP: The DPC is the SPC of the VLR, the OPC is the SPC of the HLR. SCCP: The called party number is the VLR address (E.164) and the calling party number is the HLR address (E.164).

[000128] As an alternative, the messages may be decoded in the NAR up to the application layer. The routing may then be based on the information obtained there, for example the IMSI and the MSISDN.

[000129]

E. Routing

[000130] Selection criterion for the MSISDN includes the Mobile Terminating Call ("MTC") and the Supplementary Service Handling. The selection criterion for the IMSI includes the Location Update (inscription).

[000131] The NAR is an active network element with an interface to the administration system ("ADC"). The NAR may be integrated directly as a network element in the call set-up phase for Mobile Terminating Calls ("MTC"). When the NAR is used for call set-up, performance of the NAR is important to add as little overhead in the set-up process. The NAR can be used in the signaling network as a duplicated central network element.

[000132]

F. Mobility Management

[000133] During initiation of the telecommunications network, e.g. a mobile telephony network, when a location ("VLR range") may be changed or a mobile telephone may be reactivated, the new location is reported to the HLR and corresponding data is updated as needed. The subscriber may be identified using the IMSI. In the response message, the HLR sends its network address to the VLR. From this point forward, the VLR knows the subscriber's HLR address. All further messages are sent from the VLR to the HLR are based on the subscriber's HLR address. (MAP: update location; IMSI; VLR → HLR).

G. Call Control

[000134] When a call is placed to a mobile subscriber ("MTC"), the gateway MSC queries the HLR regarding the current location of the called party. The query is carried out based on the subscriber call number ("MSISDN"). (MAP: Send-Routing Information; MSISDN; GSMC → HLR).

H. Short Message

[000135] A short message that is to be allocated to a mobile subscriber, the Short Message Service Center ("SMCS") must query the HLR for the location of the called party. Using the MSISDN, the NAR relays the message (Send-Routing-Information-For-SM) to the appropriate HLR. If the target subscriber cannot be reached, for example when the mobile telephone is turned off, the SMSC can request the HLR to inform the SMSC when the subscriber becomes available, so that the SMSC can relay the short message again. (MAP: Send-Routing-Information-

For-SM; MSISDN; SMSC → HLR) (MAP: Set-Message-Waiting Data; MSISDN; SMSC → HLR).

I. Value-Added Services

[000136] The value-added services from the VLR toward the HLR do not require any additional functions in the NAR. The messages are routed by the VLR to the corresponding HLR based on the stored network address.

[000137] Some value-added services of network elements other than the VLR may require that the NAR relay the supplementary service operation to the appropriate HLR when the HLR network address for a subscriber is not known by the other network elements. A VMSC may also initiate supplementary services.

[000138] A subscriber can use value-added services, such as a Voice Mail Service Center ("VMSC"). A MAP interface between a VMSC and a HLR may be required for the subscriber to use the VMSC. Since the VMSC does not know the network address of the HLR for the subscriber who is handling its value-added service, the NAR relays the MAP message to the HLR based on the IMSI. Other value-add services, such as Interactive Voice Response ("IVR"), may also use the NAR to relay the MAP message to the HLR based on the IMSI.

J. Authentication Center ("AuC")

[000139] In a mobile telephony network, the function of the AuC can also be integrated into each HLR for the subscriber data records stored in this HLR. The VLR may query the AuC for the authentication information. If the network address of the HLR is not known in the VLR when the subscriber is initiated into the network, the NAR must relay the MAP messages for authentication to the HLR/AuC based on

the IMSI. (MAPv1: Send-Parameters; IMSI; VLR → HLR/AuC). (MAPv2: Send-Authentication-Info; IMSI; VLR → HLR/AuC).

K. SIM Card Handling

[000140] When a SIM card of a subscriber needs to be replaced, for example when a SIM card is defective or when new services are introduced, the subscriber may wish to retain the same calling number. A SIM card may need to be replaced, for example, when a SIM card is defective or when new services are introduced. Thus, when a SIM card is replaced, the MSISDN remains the same and a new IMSI is assigned to the subscriber. Replacement of a large number of SIM cards occurs regularly. Because the NAR allows flexible allocation of MSISDNs and IMSIs to subscribers and HLRs, the administrative costs of SIM card replacement is greatly reduced. When a new service is introduced, new SIM cards may be required for a large number of subscribers.

L. International Roaming

[000141] Call control of international roaming calls may not generate any special requirements for the NAR.

M. Data Security and Privacy

[000142] No subscriber data, such as supplementary services or call forwarding destinations, are stored on the NAR. The HLR may maintain the subscriber profile as in conventional systems. Only routing data is stored in the NAR. The routing data describes the network element in which the subscriber data are located. The NAR, therefore does not create any special data security or privacy concerns.

N. Intelligent Network ("IN")

[000143] The subscriber data is stored in the HLR for GSM services. Similarly, the subscriber data for a subscriber's IN services are stored in the Service Control Point ("SCP"). If the network contains multiple SCPs, the NAR also determines the appropriate SCP on which the subscriber's data is stored.

[000144] The two main types of services, subscriber-specific services and network-wide services, may be handled differently. Subscriber-specific services may require that the associated subscriber data be available before the IN service is provided. The subscriber-specific data may be stored on the SCP. Thus, the NAR determines the SCP associated with the subscriber and hands over service control to that SCP. INAP: InitialDP, service key, calling party number ("MSISDN"), IMSI, and IMEI for originating services. INAP: InitialDP, service key, called party number ("MSISDN"), IMSI, and IMEI for terminating services such as terminating call screening.

[000145] While network-wide services normally do not use subscriber-specific data, the SCP on which the service logics are implemented must be determined before network-wide services can be provided. The routing criterion for selecting the appropriate SCP is based on a service key and not the subscriber's calling number. INAP: InitialDP and service key.

O. Local Number Portability ("LNP")

[000146] When a customer in the fixed network changes his telecommunications carrier, the customer may wish to retain the same calling number (telephone number). The destination network of the called party can be determined during the call set-up phase by the source network (on-call inquiry). A database in which the

ported subscribers are registered is queried in the source network. Due to the expected high dynamic load generated by the database queries, the database preferably is a high speed database. The NAR may include the LNP database.

P. Mobile Number Portability ("MNP")

[000147] The European Telecommunications Standards Institute ("ETSI") is working to standardize MNP. The options includes a MAP protocol and an INAP protocol. The NAR may be configured to conform either protocol in terms of call control, mobility management, and supplementary service handling (e.g. for CCBS). The NAR may also be configured to conform other protocols.

Q. Optimized Voice Mail Routing

[000148] For capacity reasons, numerous Voice Mail Service Centers ("VMSC") may be used in the mobile telephone network. In conventional systems, subscribers are allocated to a VMSC based on the customer's calling number. A more economical allocation method is to allocate a subscriber to the VMSC based on the subscriber's most frequent location. That is, the VMSC allocation is based on subscriber-specific information rather than a block-wise allocation. The NAR determines the appropriate VMSC similar to how the NAR determines the appropriate the HLR.

R. Equipment Identity Register ("EIR")

[000149] Optionally, the NAR may use the IMEI to determine the appropriate EIR for an inquiry. Under the current standards, only the address of an EIR can be entered in the MSC and routing can not be apportioned by IMEI blocks. This means that each IMEI must store each EIR. This creates data consistency concerns. In an improved system, routing to the EIR may be apportioned regionally. With a single

NAR in the telephone network, routing could be implemented using the IMEI and potential data inconsistency can be ruled out. MAP: Check-IMEI and IMEI.

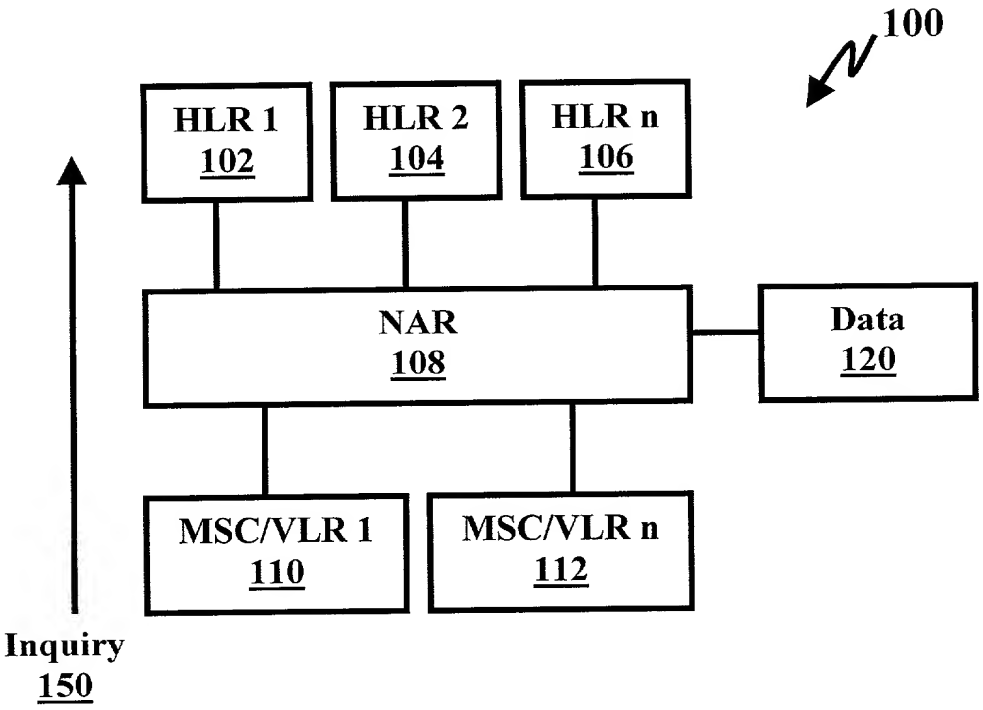
S. Subscriber Administration

[000150] As an expansion of the functionality of the NAR, an ABC may respond like an HLR. All activations and changes are sent to the NAR. The NAR then determines the appropriate HLR and relays the message to that HLR.

[000151] By introducing the NAR in the areas described above, many tasks can be solved more efficiently resulting in cost savings that outweigh the cost of the NAR. In addition to the cost savings, the capacity utilization of the network elements may be optimized. The optimization results in additional capacity and may eliminate the need for additional network elements.

[000152] As a person skilled in the art will recognize from the previous description and from the figures and claims, modifications and changes can be made to the preferred embodiments of the invention without departing from the scope of the invention defined in the following claims.

1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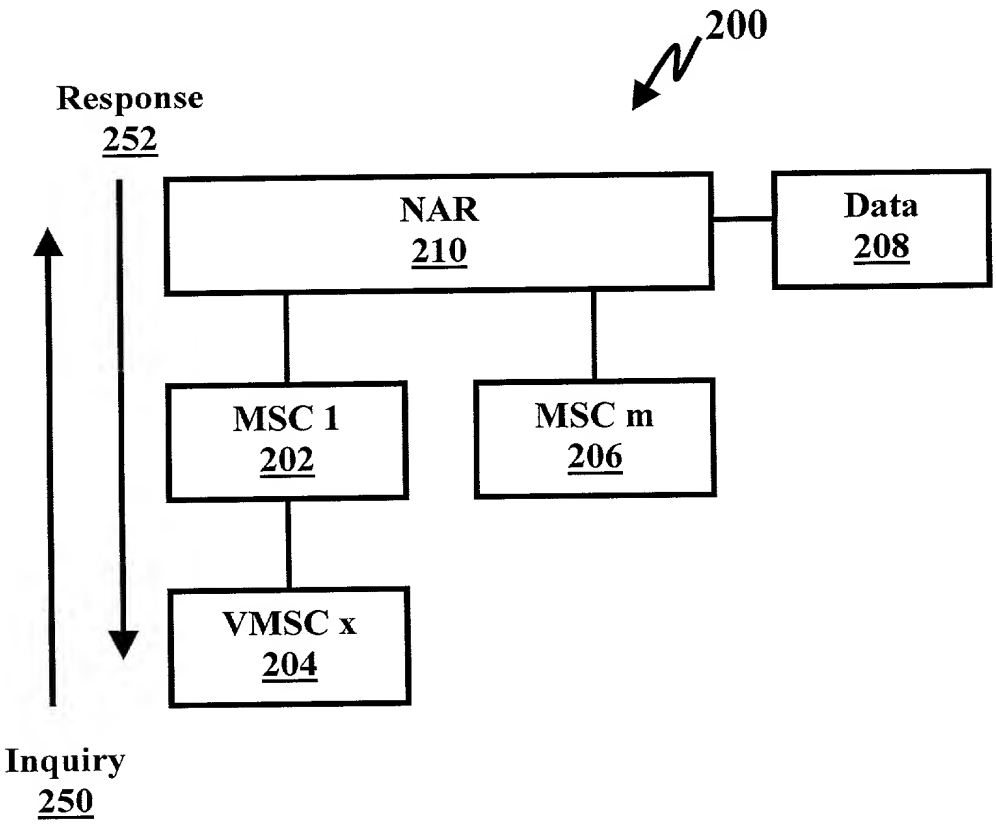
HLR 1
102
HLR 2
104
HLR n
106
NAR
108
Data
120
MSC/VLR 1
110
MSC/VLR n
112
Inquiry
150

Figure 1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NAR
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MSC m
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VMSC x
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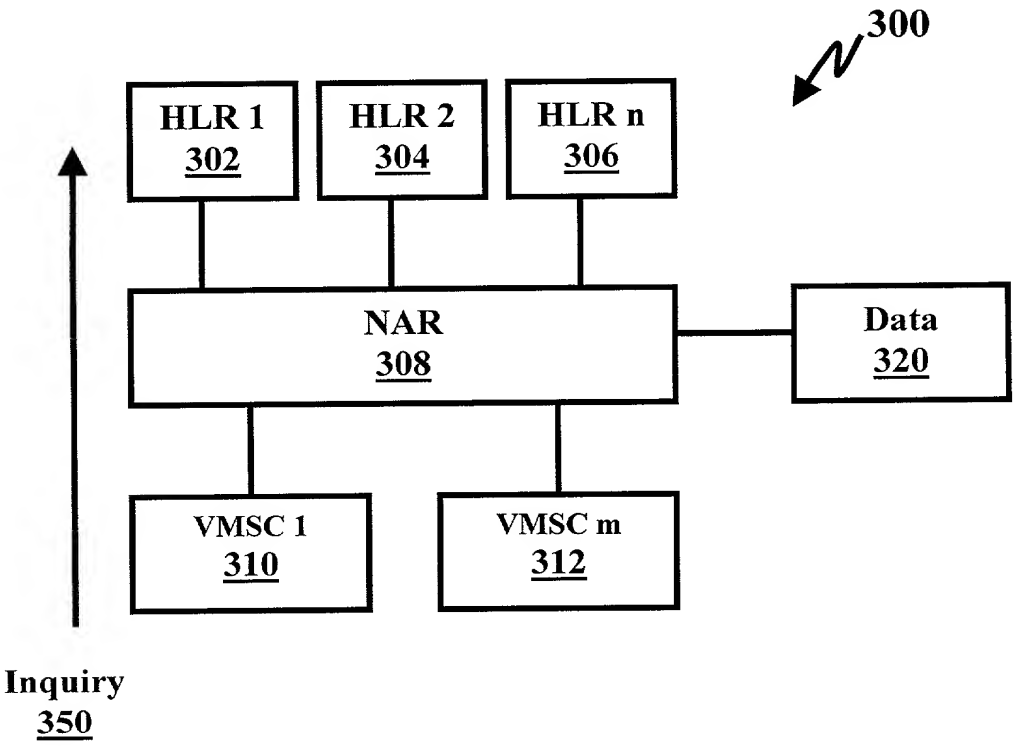
Inquiry
250

Figure 2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HLR 1
302
HLR 2
304
HLR n
306
NAR
308
Data
320
VMSC 1
310
VMSC m
312
Inquiry
350

Figure 3

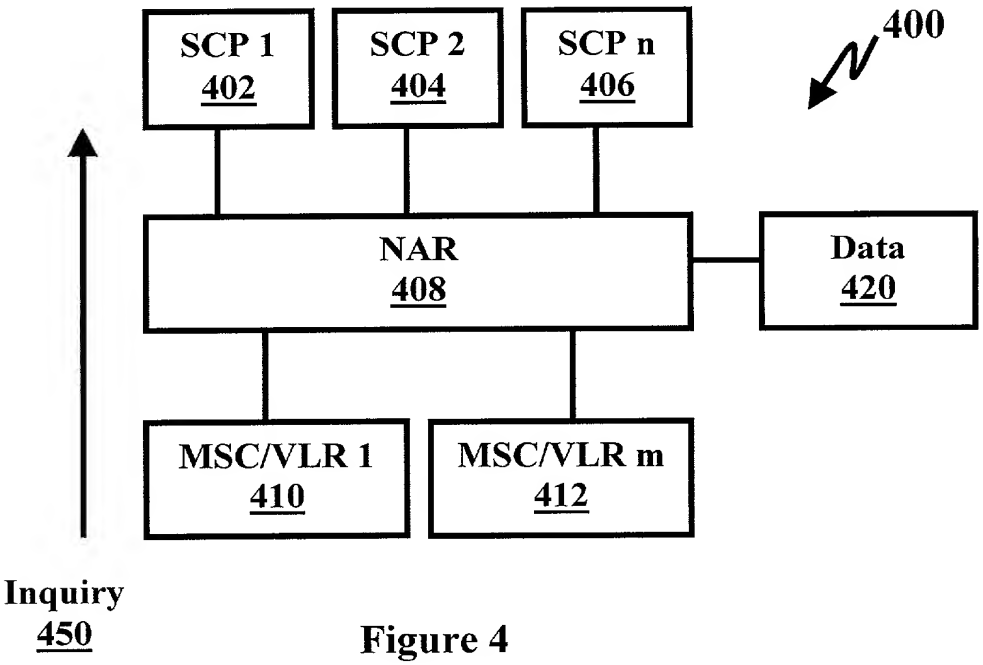

Figure 4

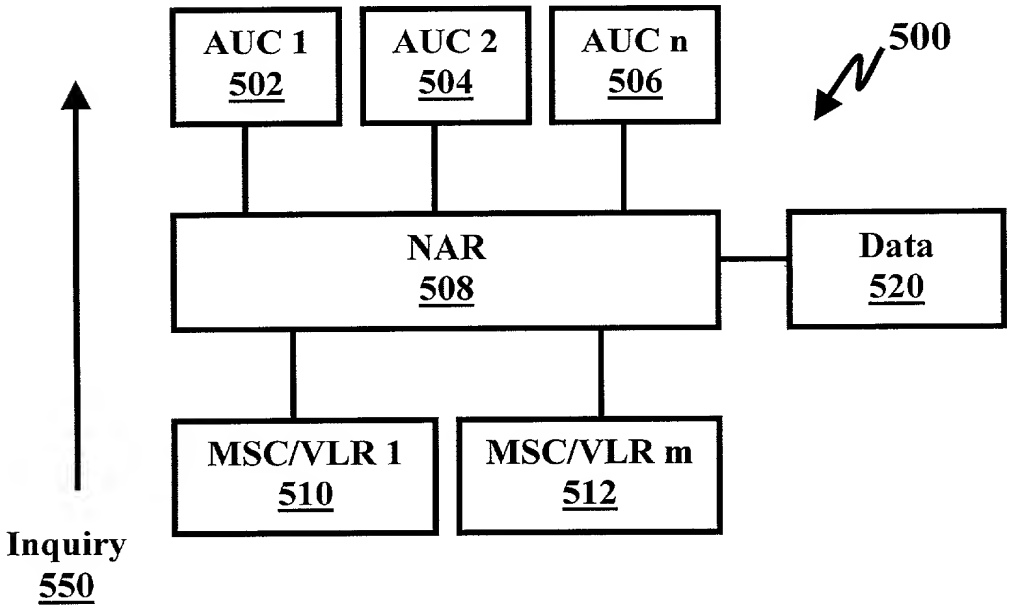

Figure 5

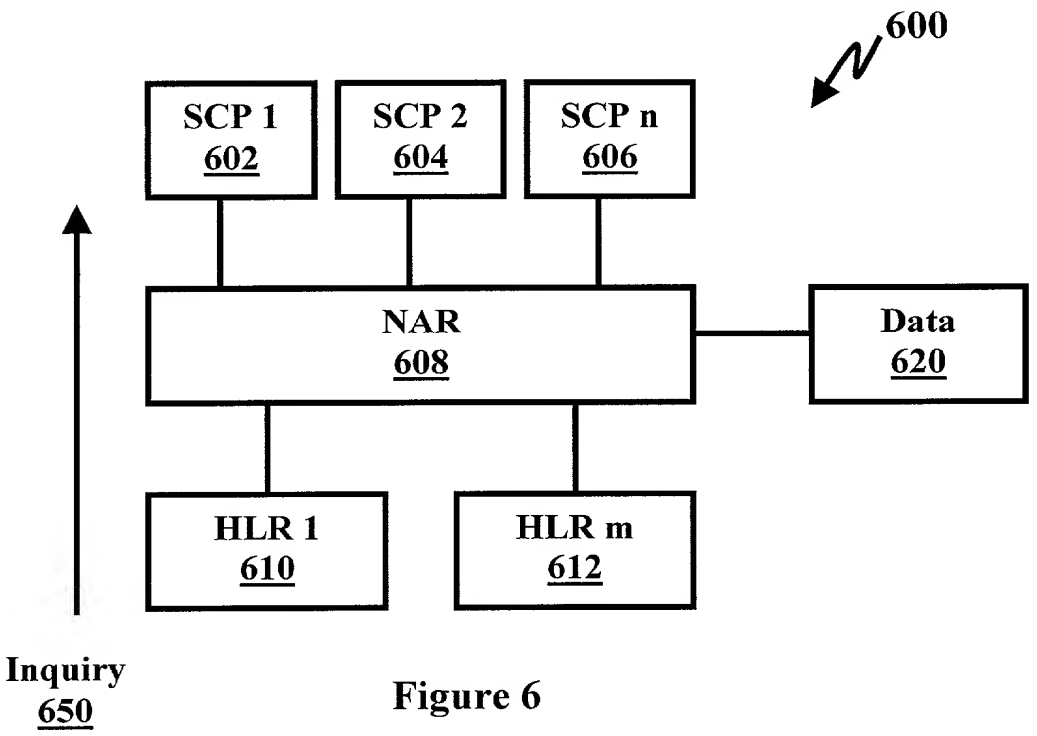

Figure 6

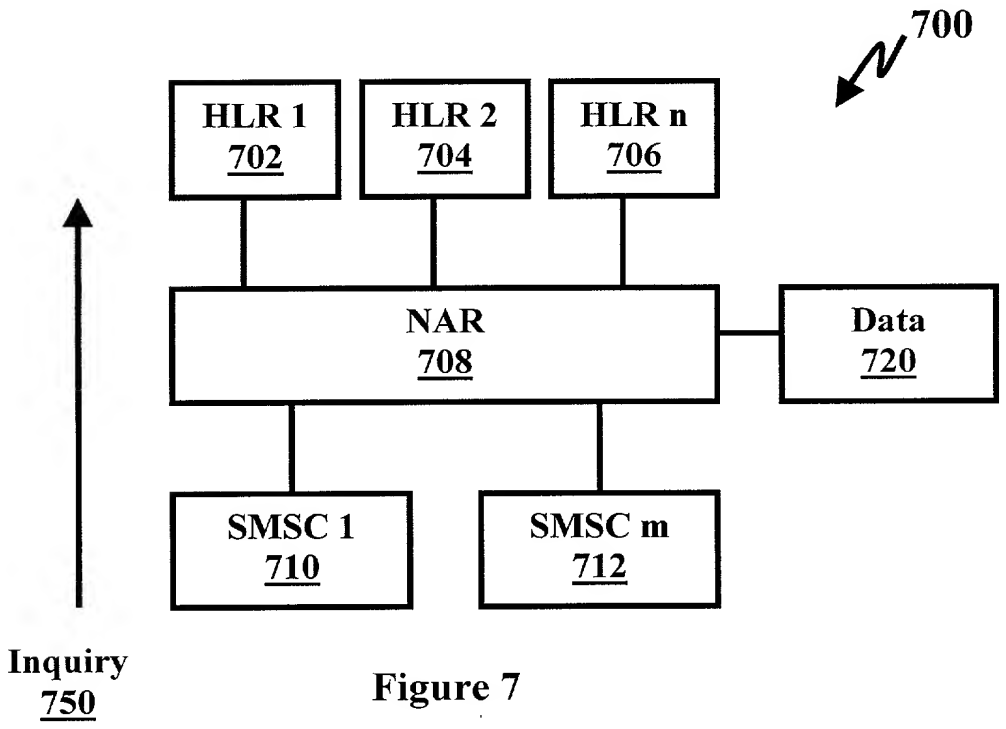

Figure 7

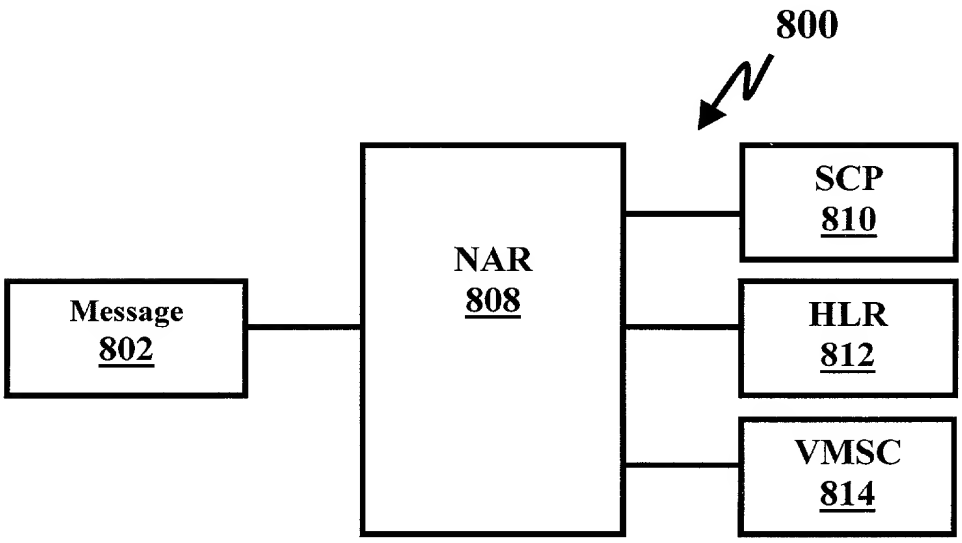

Figure 8

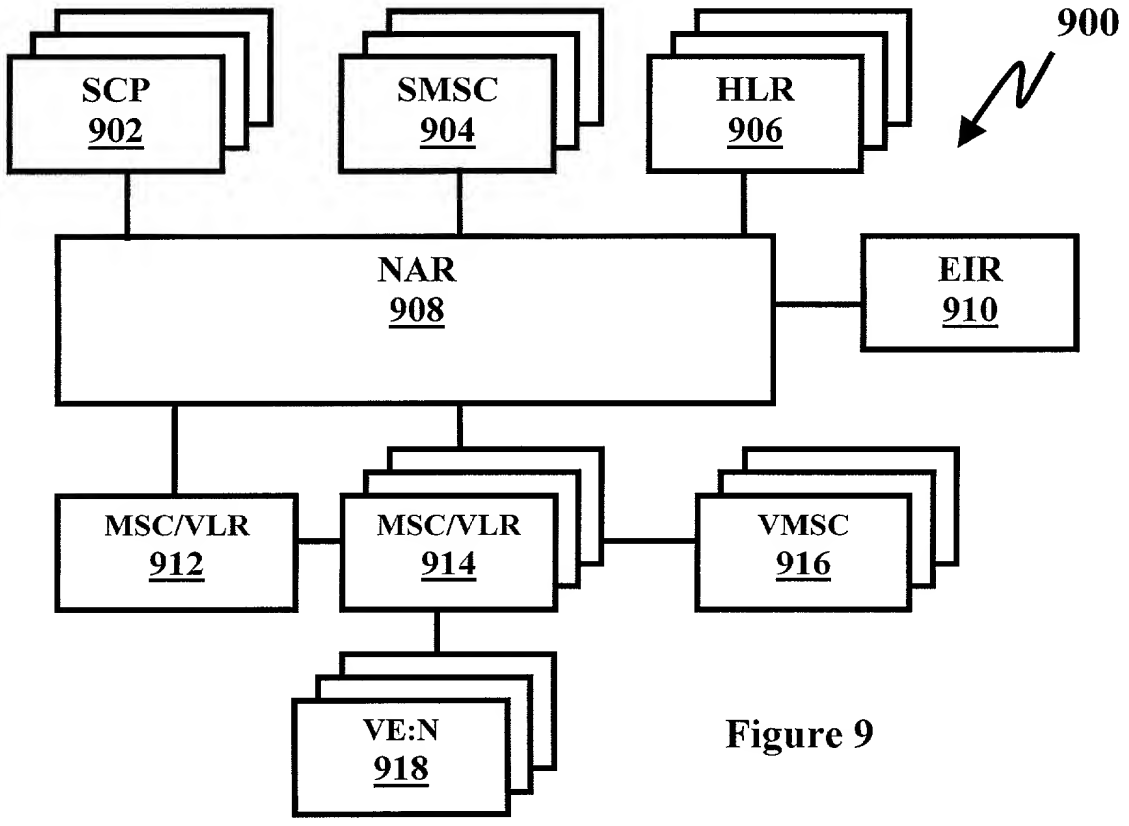

Figure 9

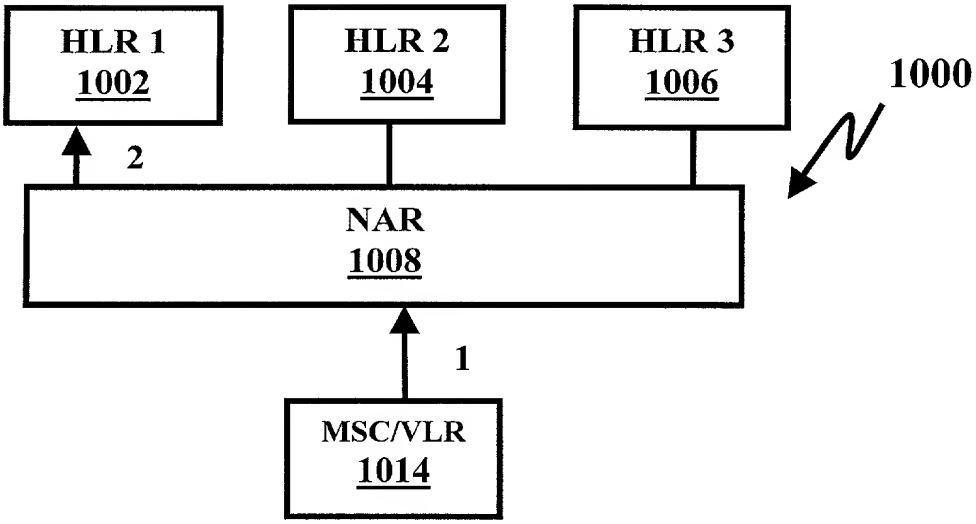

Figure 10

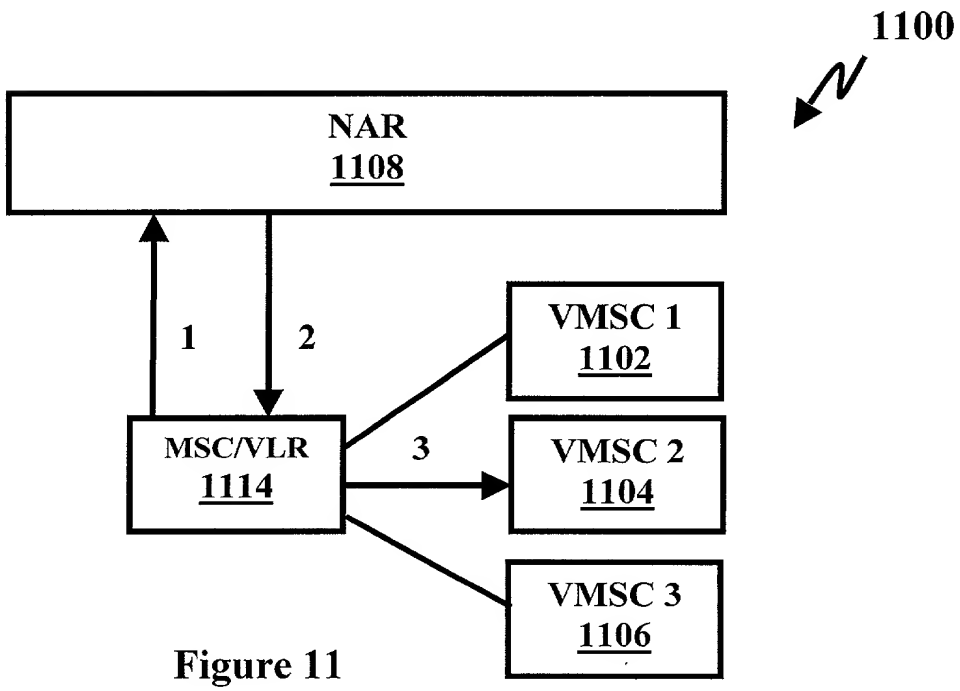

Figure 11

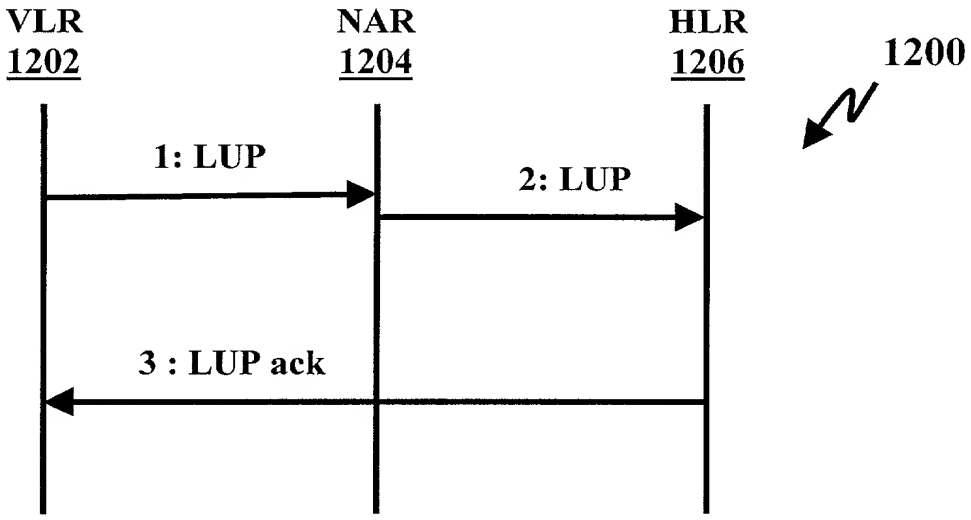

Figure 12

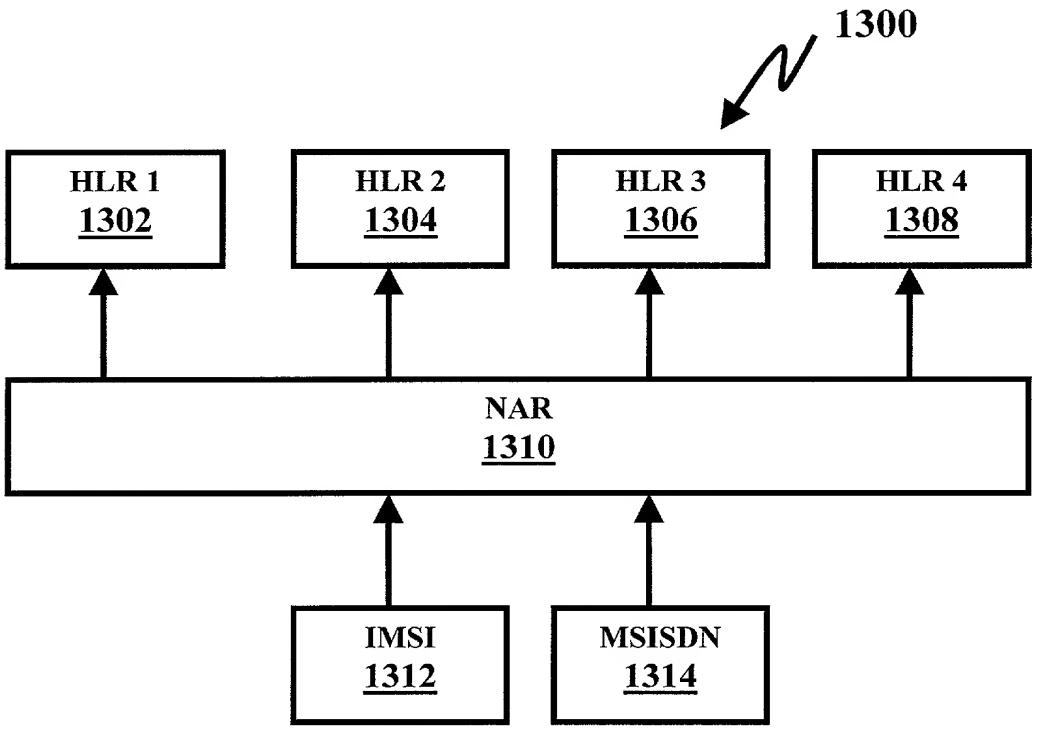

Figure 13

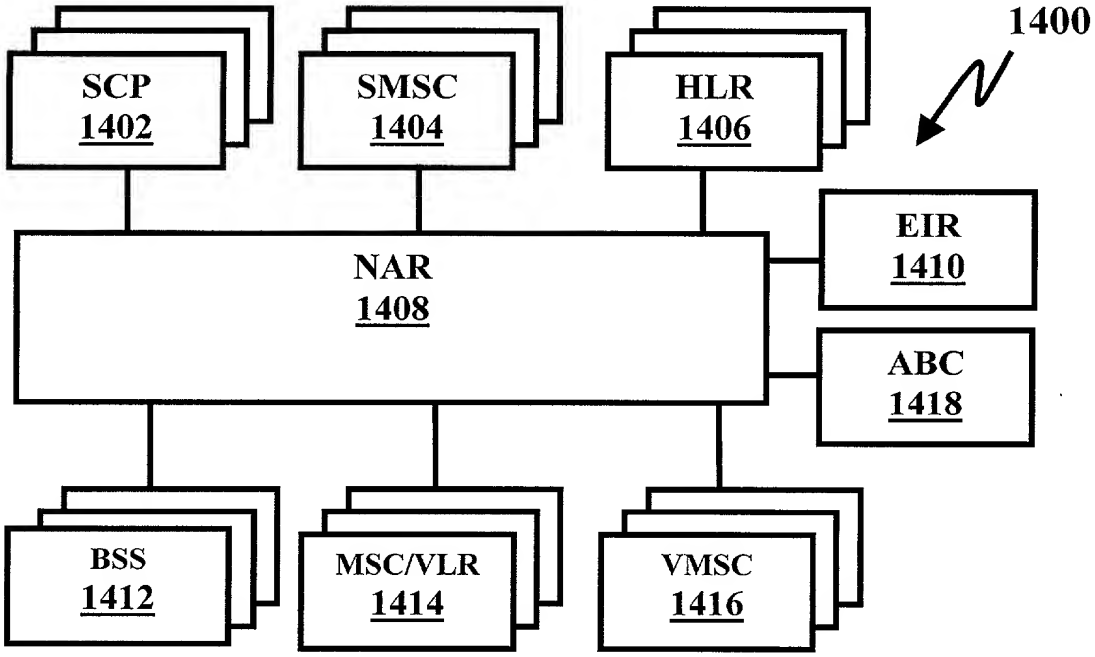
1400
SCP
1402
SMSC
1404
HLR
1406
EIR
1410
NAR
1408
ABC
1418
BSS
1412
MSC/VLR
1414
VMSC
1416

Figure 14

Case No. 11086/3

DECLARATION FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled METHOD FOR ROUTING MESSAGES IN A TELECOMMUNICATION NETWORK, the specification of which:

☒ is attached hereto.

☐ was filed on _____ as Application Serial No. _____.

☐ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability as defined in Title 37, Code of Federal Regulations, § 1.56(a).

I hereby claim foreign priority benefits under 35 U.S.C. § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
(Number)	(Country)	(Day/Month/Year Filed)	☐ Yes	☐ No

I hereby claim the benefit under 35 U.S.C. § 119(c) of any United States provisional application(s) listed below:

(Application Serial No.)	(Filing Date)

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

PCT/EP99/07884	October 18, 1999	Pending
(Application Serial No.)	(Filing Date)	(Status-patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Case No. 11086/3

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